MODERN PLASTICS

OCTOBER 1960

PHOTOGRAPHED FOR MODERN PLASTICS BY RAY CICERO

PLASTICS IN THE PRODUCT REVOLUTION: Dolls *p. 100*

Building markets can be cracked—vinyls show how *p. 83*

When to mold, when to machine *p. 90*

New role for melt extractor *p. 107*

How plastics solve nose cone ablation problems *p. 135*

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MODERN

• THE PLASTISCOPE

Section 1 . . . . . **39**

Section 2 . . . . . **212**

What's the status of the polyvinyl alcohol industry? . . . PE coating resins—prices, markets, new developments . . . Companies producing polystyrene . . . A new family of solid urethane foams . . . First electric shaver housed in nylon . . . A new Du Pont polyolefin division.

• EDITORIAL

Let's keep our eyes on GATT **260**

What decisions affecting the U. S. plastics industry will be made late this year under the General Agreement on Tariffs and Trade? Will preferred treatment for "underdeveloped" nations jeopardize our new raw materials production?

• GENERAL

Tomorrow is today for vinyls in construction **83**

While a lot has been written concerning plastics' potential in the building industry, most materials have attained only very limited penetration. The big exception is vinyl. Millions of pounds of the resin have gone into such applications as weather stripping, channeling, water stops, sash, doors, windows, conduits, siding, and surfacing. Equally as important as the volume usage is the fact that through vinyl many companies that never had a connection with plastics are now heavily committed to the plastics field, providing new outlets for machinery and material. This first article in a series spells out what is being done with extruded vinyl, by whom, and why.

Autoclavable carafe **89**

What is thought to be the first U. S. application of blow molded polypropylene provides hospitals with combination cup-decanters that weigh up to 66% less than stainless steel and glass containers, protect better against infection.

To mold or to machine? **90**

Generally speaking, contour of part and size of run will determine the user's choice between molding and fabricating a plastic component. Five actual products—of varying configurations—have been costed out in detail to show where the break-even point lies and how it varies from part to part.

Progress in styrene-acrylonitrile copolymers **93**

Despite their premium price, these resins are finding growing acceptance in numerous industries. Reason: their outstanding properties very often allow them to replace higher-cost nonplastic materials. Several applications are cited to show outstanding uses. An analysis of the overall market and a discussion of molding conditions round out the picture.

Liquid cure speeds plastisol molding . . **96**

Manufacturer of marine buoys achieves 60% saving in cycle time by substituting a heated-liquid system for the conventional hot-air cure to fuse the material.

RP molds bring 85% die cost reduction **98**

Conversion of stock cars to special purpose vehicles becomes economically feasible by switching from metal to reinforced epoxy dies, from die-stamped metal components to molded reinforced polyester parts.

Plastics in the product revolution: Dolls 100

In a relatively short time, plastics' share of the American doll market has grown from zero to about 95 percent. In this process celluloid, acetate, butyrate, vinyl, polyethylene, acrylics, and polyvinylidene chloride have all made important contributions. The vagaries of this development, starting with injection molded heads and bodies in 1946 and culminating in the blow-molded torso of today, are traced in this month's cover story.

Plasticizer production, sales—1959 . . **158**

A definitive analysis of what happened to plasticizers in 1959—which showed a 25% sales increase over 1958—and a rundown of how much of the various types was produced and what their most important markets are.

Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y. Please mail all correspondence, change of address notices, subscription orders, etc., to above address. Quotations on bulk reprints of articles appearing in this issue are available on request.

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PLASTICS*

OCTOBER 1960
Volume 38 Number 2

New developments **168**
Better bowling bags for 25% less . . . Special techniques for faster, simpler production . . . Multipurpose letter opener . . . Laminate in die-cut strip . . . Foam package replaces cardboard . . . Magnetic vinyl for level . . . Acetal for computer part . . . Vinyl boat markers.

• ENGINEERING

Melt extractor moves into new role—preplastication **107**
Adaptable to existing commercial machines, new preplasticating injection system can be used to increase production rates and improve the quality of the molded parts. Here's how it works, what economies it brings. *By Albert Spaak.*

Orientation in injection molding **113**
How gate, cavity dimensions, and other process variables can act as controlling factors in determining the net orientation in a molded piece. *By R. L. Ballman and H. L. Toor.*

How to extrude plastisols **127**
New system that pump-feeds plastisols overcomes surging and low production rates in extrusion. *By C. H. Brower and B. H. Maddock.*

• TECHNICAL

The ABMA reinforced plastics ablation program **135**
Work done at the Army Ballistics Missile Agency Arsenal, Redstone, Ala., is outlined. Tests indicate that the efficiency of RP ablation system increases with increasing heating rates; there is, therefore, no practical upper limit to the thermal environment to which these plastics might be applicable. *By W. R. Lucas and J. E. Kingsbury.*

Tung oil and its derivatives in polyesters **144**
Tung oil, when mixed with polyester resin, shortens gel time and decreases the temperature rise in room temperature cure. Relatively large amounts of the oil can be incorporated in an unsaturated polyester. A material of this type is a heat-hardening resin which can be used in baked coatings and casting compositions. *By Frank B. Root and Roger W. Amidon.*

Plastics production in 1959 grouped by chemical composition **153**

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Coming Up . . .

What Detroit has done with plastics in cars, why, and with what results will be the subject of our November lead . . . Engineering section will investigate the effects of processing conditions on the properties of molded polypropylene . . . Also, will present a new method of biaxially orienting high-density PE pipe to obtain the same burst strength with markedly reduced wall . . . Technical section leads off with a detailed study of behavior of plastics in re-entry environments.

The index to Vol. 37 of Modern Plastics (Sept. '59-Aug. '60) is now available gratis to subscribers who request it. Address Readers' Service Editor, Modern Plastics, 575 Madison Ave., New York 22, N.Y.

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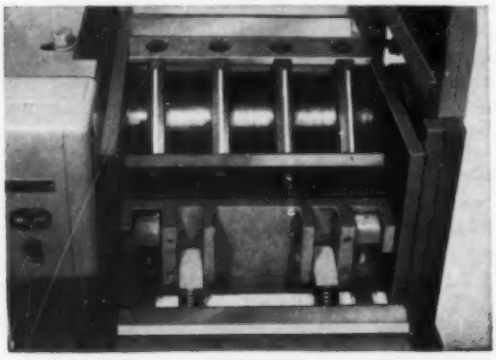

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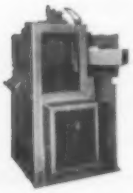

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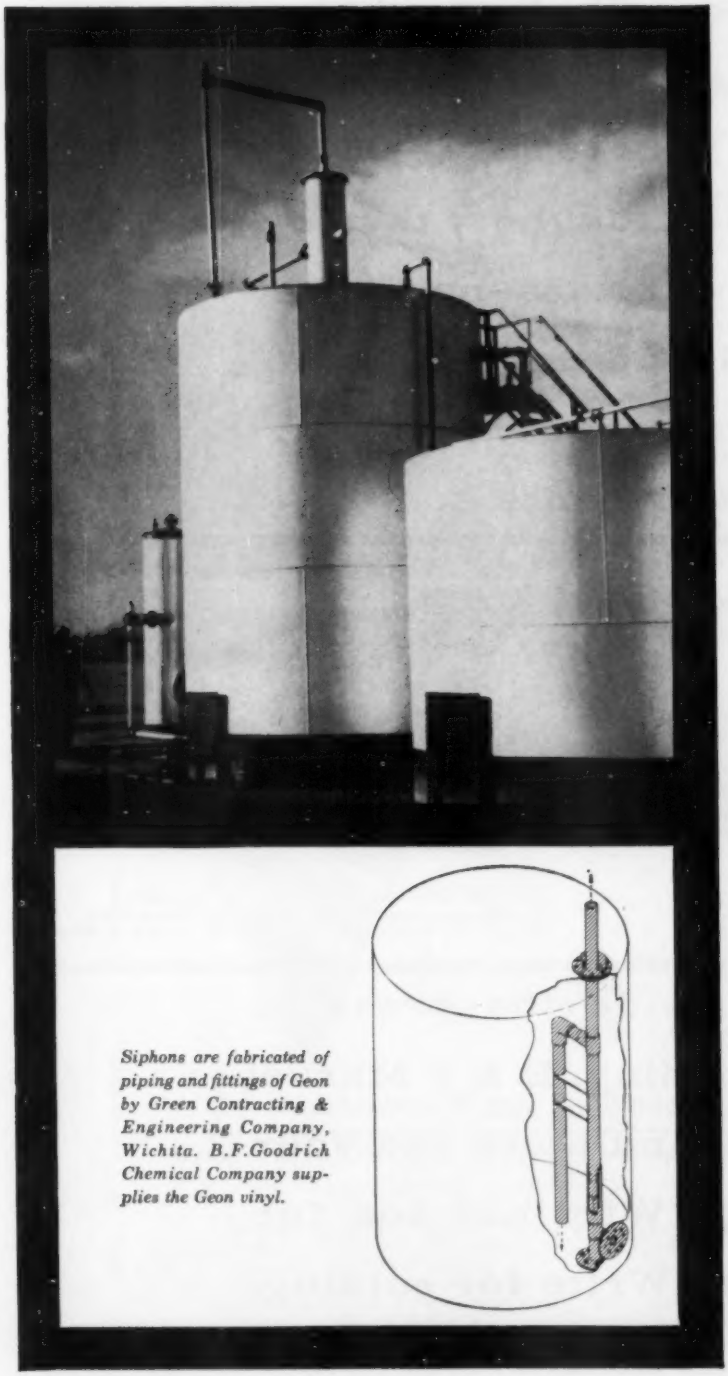

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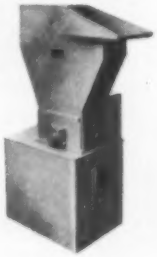

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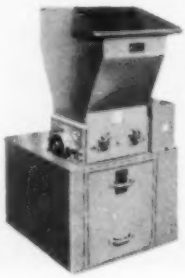

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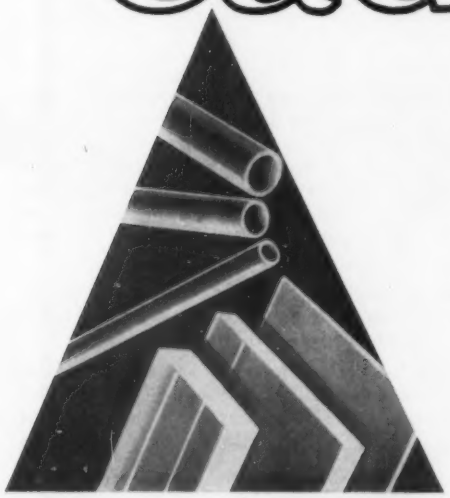

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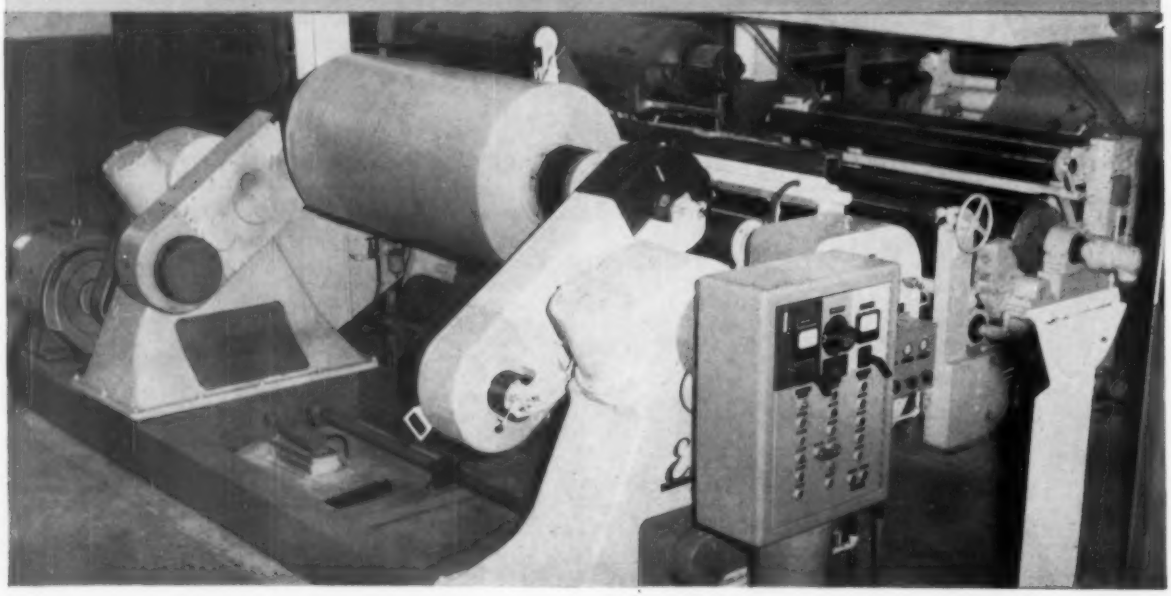

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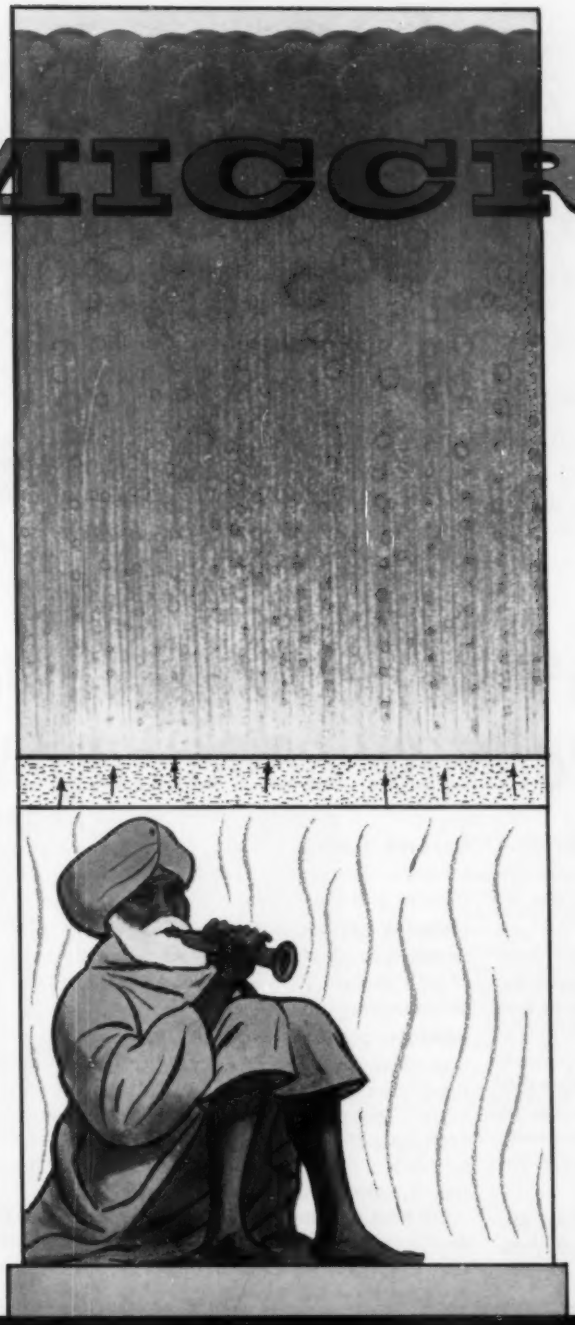

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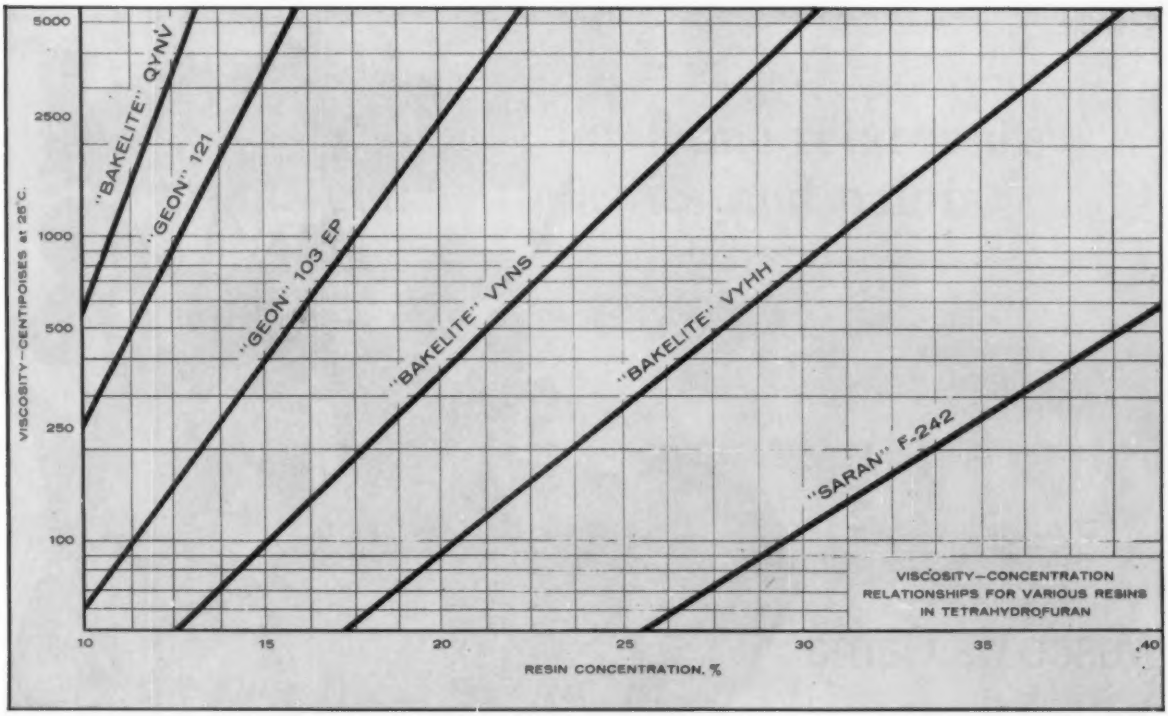

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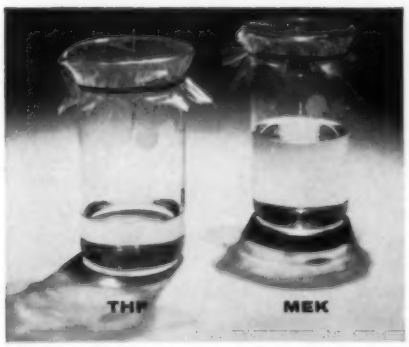

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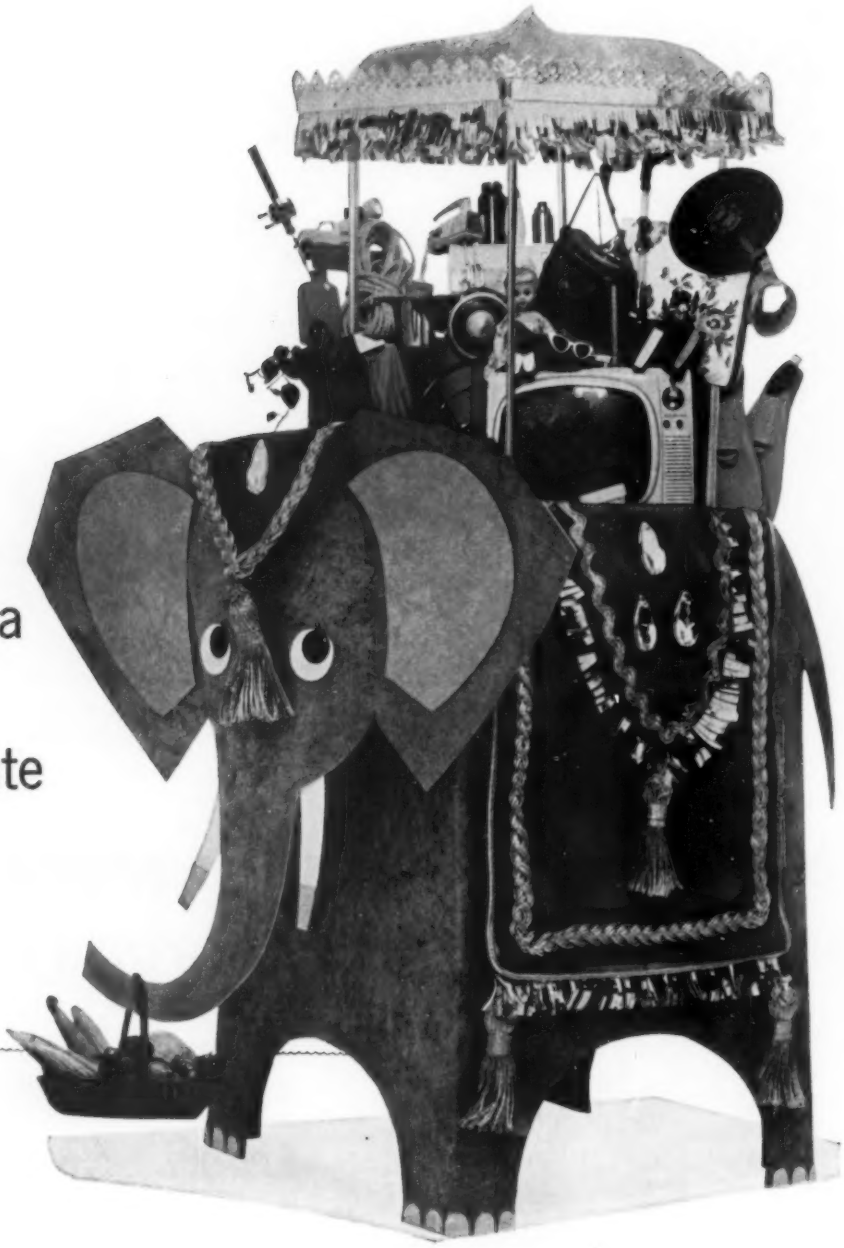

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A unique pigment for flame retardance in halogenated plastics and paints

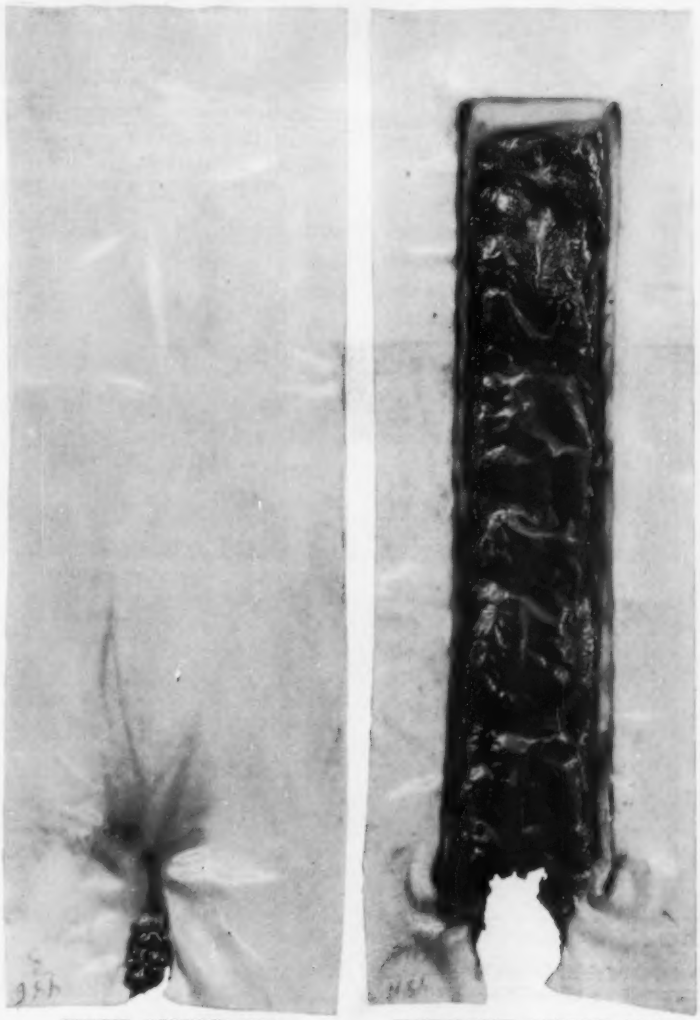
Never before has there been a pigment like ONCOR® 23A, developed especially for compositions based on halogenated resins. This pigment is composed of an inert silica core of low specific gravity, and has a surface layer of antimony oxide fused to the core.

Here's a quick run-down on the outstanding features of this significant new pigment:

1. **Effective Flame Retardance** – ONCOR 23A pigment compares favorably with conventional antimony oxides in flameproofing efficiency in halogen-containing resins for plastics and paints. In tests on vinyl films, ONCOR 23A pigment has given equivalent flame resistance compared to conventional antimony oxide, on an equal weight basis.
2. **Low Tinting Strength** – ONCOR 23A pigment has a low and uniform tinting strength. In vinyl film tests, tinting strength consistently measures between 60% and 65% of a conventional antimony oxide standard. This allows most effective use of colorants.
3. **Low Specific Gravity** – Because of its special physical structure, ONCOR 23A pigment has a lower specific gravity than regular antimony oxides. This means a higher volume yield per pound of pigment.
4. **Excellent Dispersion Characteristics**—as a result of careful production controls, ONCOR 23A pigment has a particularly uniform particle. This assures consistently good dispersion in both plastics and paints.

ONCOR 23A pigment is suggested for use in all halogenated plastic and paint compositions requiring flame resistance. It may be used with polyvinyl chloride, vinyl chloride copolymers, chlorinated paraffins, chlorinated rubber, chlorosulfonated polyethylene, chlorinated polyesters and the commercial fluoropolymers.

Additional information on the new ONCOR 23A pigment is provided in the National Lead Company Data Sheet just off the press. The handy coupon at the right will bring you a copy by return mail.



WITH ONCOR 23A **WITHOUT ONCOR 23A**

These two samples show typical flammability test results on vinyl film, following the procedure specified in ASTM D-1433-58. (See Item 1 in text.)

KC-6295

NLC

National Lead Company: General Offices, 111 Broadway, New York 6, N.Y. In Canada: 1401 McGill College Avenue, Montreal.

Gentlemen: Please send your new Data Sheet for ONCOR® 23A, antimony silico oxide pigment for flame retardance in halogenated plastics and paints.

Name _____ Title _____

Company _____

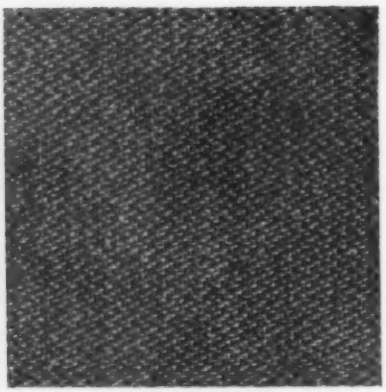
Address _____

City & Zone _____ State _____

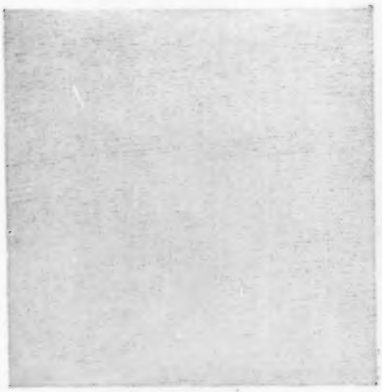
23A an **oncor** *Pigment... A Development of* **National Lead Company**

General Offices: 111 Broadway, New York 6, N.Y.

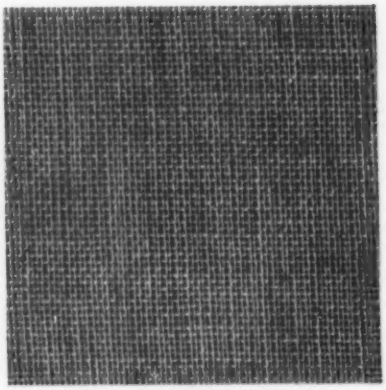
unrivaled... the variety and quality of WELLINGTON SEARS fabrics for coating



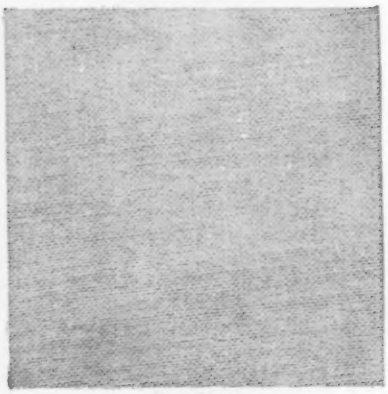
Cotton Broken Twill



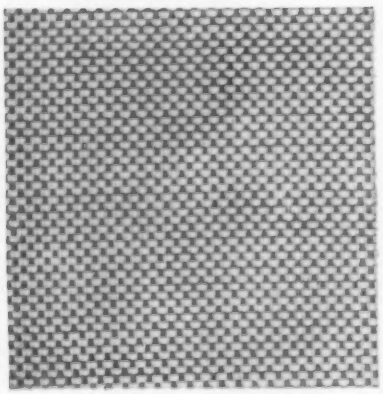
Spun Dynel



Cotton Chafer



Spun Rayon



Welkote Filament Nylon

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Shown here is just a tiny sample of the many quality base fabrics offered by Wellington Sears for both plastic and rubber coating. The entire selection is more complete and up-to-the-minute than can be found anywhere else in the textile industry.

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● Screw-thrust rides on patented, heavy-duty bearing system.

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Mapre Twin-Screw Extruders are sold in the U.S. exclusively through the Reed-Prentice Division of Package Machinery Company. For complete technical data, contact your Reed-Prentice Sales Engineer.

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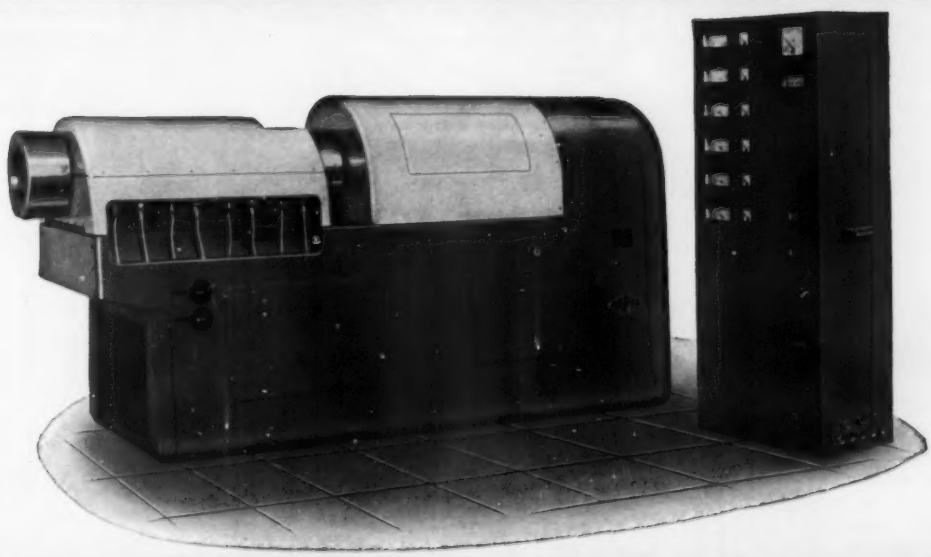

Wheelco Series 8000 Electronic Potentiometer Recorders. Self-contained, null-balance units featuring plug-in components and convenient, swing-out design.

Wheelco Series 400 Capacitrol Indicators. Electronic measuring system and DC power supply in single unit.

Dynisco Pressure Transducer. Non-fouling sensing tip.

New concepts do. The old-time typewriter above still does the job it was designed to do. So do the control instruments in the plastics industry. And, they will continue to do a good job. But . . . do they keep pace with todays' plastic processing needs? Here are new concepts to supplement and upgrade the instrumentation you now use —

INDICATING RECORDERS . . . Record any combination of *temperature* and *pressure* up to 24 points • Indicate temperature and pressure on separate scales • Accept as many as six limit switches — high or low limit.

SERIES 400 INDICATOR . . . Read temperature or pressure directly by flipping a selector switch • Stable voltage regulation with Zener diode circuit • High or low-limit alarm signals.

PRESSURE TRANSDUCER MODEL PT-58 . . . Fast, accurate response during extrusion • Specially designed for plastics; fit standard thermocouple openings.

These are some of the Wheelco features that have set standards in the plastics industry. Contact your nearest Wheelco Sales and Service Office for complete information.

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GERING Thermoplastic MOLDING COMPOUNDS

quality formulated to perform as required!

Roaring down the Atlantic test range or blasting off from the living room floor, true missile performance depends on the accurate behavior of individual components. That's where Gering's expert ability to formulate superior thermoplastic Molding Compounds comes in. Whether the end use is a vinyl jacketing compound that helps trigger a giant ICBM into space or an impact styrene toy replica, quality Gering Molding Compounds perform to perfection. Extensive laboratory and production facilities enable Gering to produce to your most exacting specifications — including flame-retardant, non-toxic, semi-conductive and other special formulations. And with these complete facilities at your service, your most demanding custom compounding requirements can always be met. Tell us your specific needs. We'll be happy to submit a recommendation at no obligation. Write today for information.

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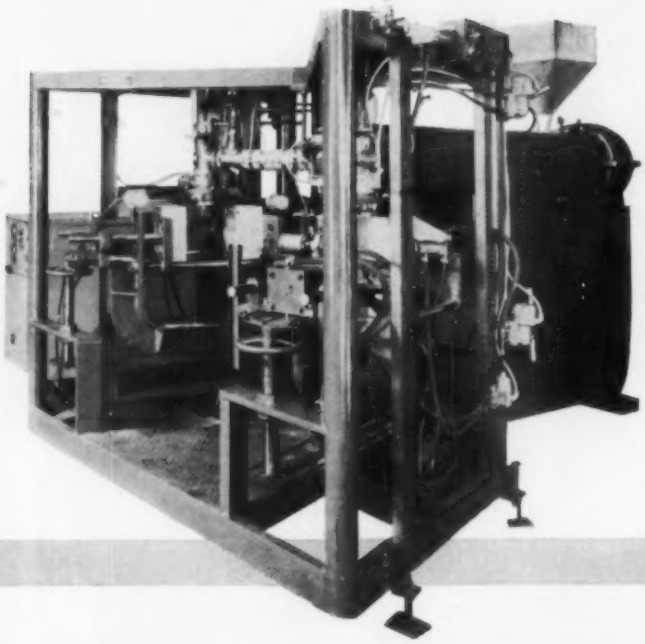
Interested in Blow Molding?



MPM's new "Diversamatic" twin-station is the fastest, most versatile unit available.

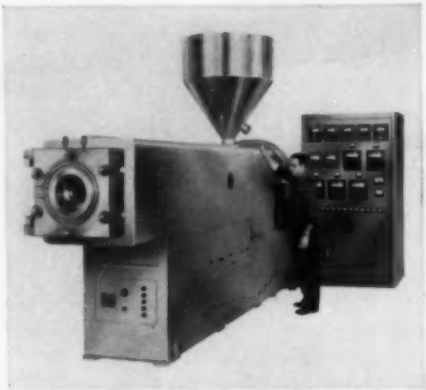
You owe it to yourself to check the advanced design features of MPM's new "Diversamatic" blow-molding machine.

Unique twin-station design lets you operate two identical or different molds at the same time. Once the machine is set up (easily done with manual controls), you switch over to automatic for high-speed, continuous operation.

You can produce single or vertically strung multiple-cavity work in lengths of up to nearly three feet! Materials blown include low- and high-density polyethylene, polypropylene, high-impact styrene, nylon and other materials.

The "Diversamatic" can be used with *any* extruder, domestic or foreign. If you wish, MPM will provide the *complete* unit, including extruder (see photo at right). Moreover, MPM will operate the unit for your inspection *prior* to shipment, then help you put it into operation in your plant.

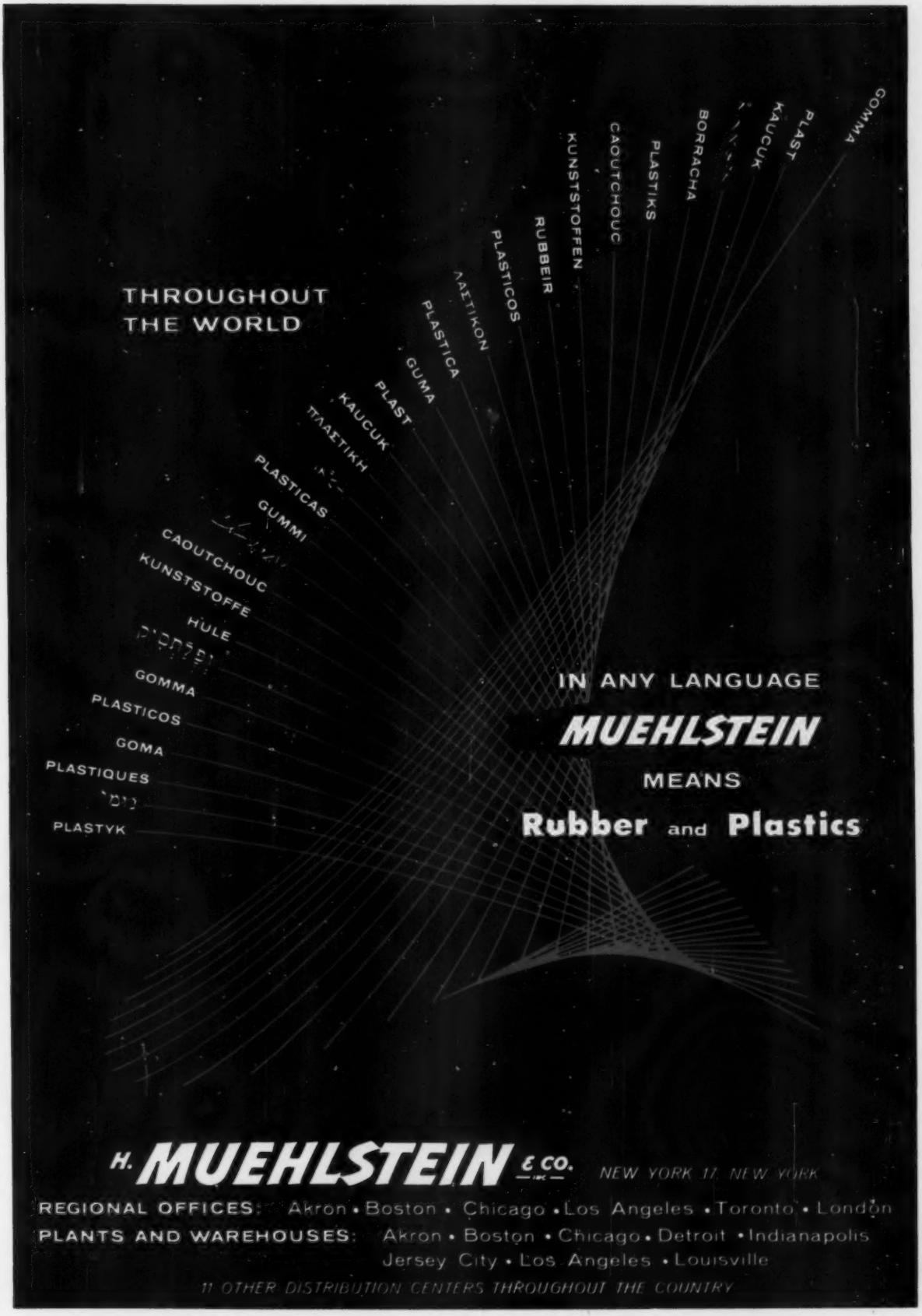
In addition to the "Diversamatic," MPM manufactures a one-station, two-head machine, two-station machines with either four or eight heads, and a new six-station *rotary* machine. For information on any or all of these, just drop us a note.



MPM COMPLETE PACKAGE UNIT includes an MPM extruder, "Diversamatic" twin-station blow-molding equipment, and the tooling, if desired.

Modern Plastic Machinery Corporation

General offices and engineering laboratories: 64 Lakeview Avenue, Clifton, N. J.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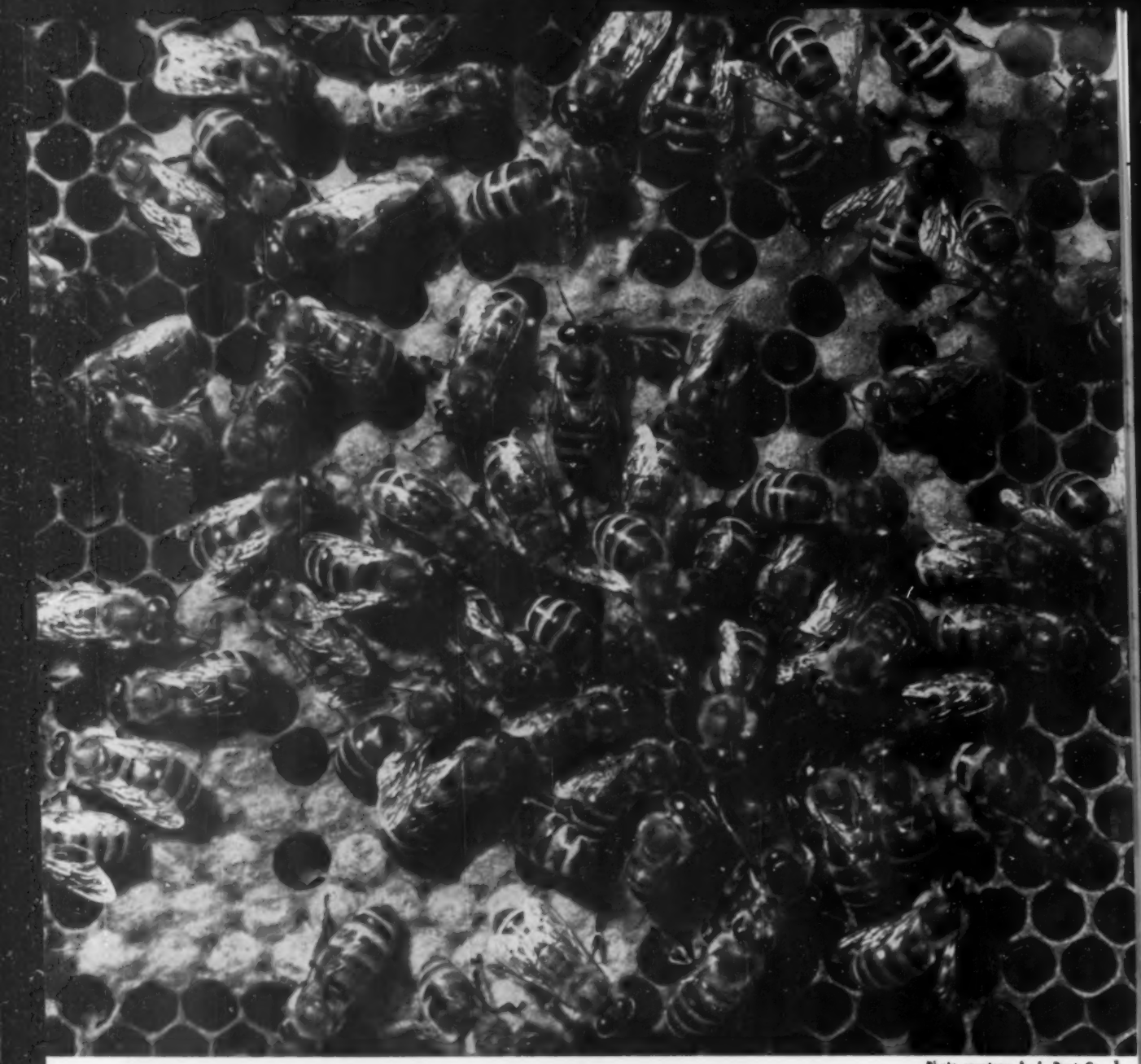


Photo courtesy A. I. Root Co.

space-saving design...

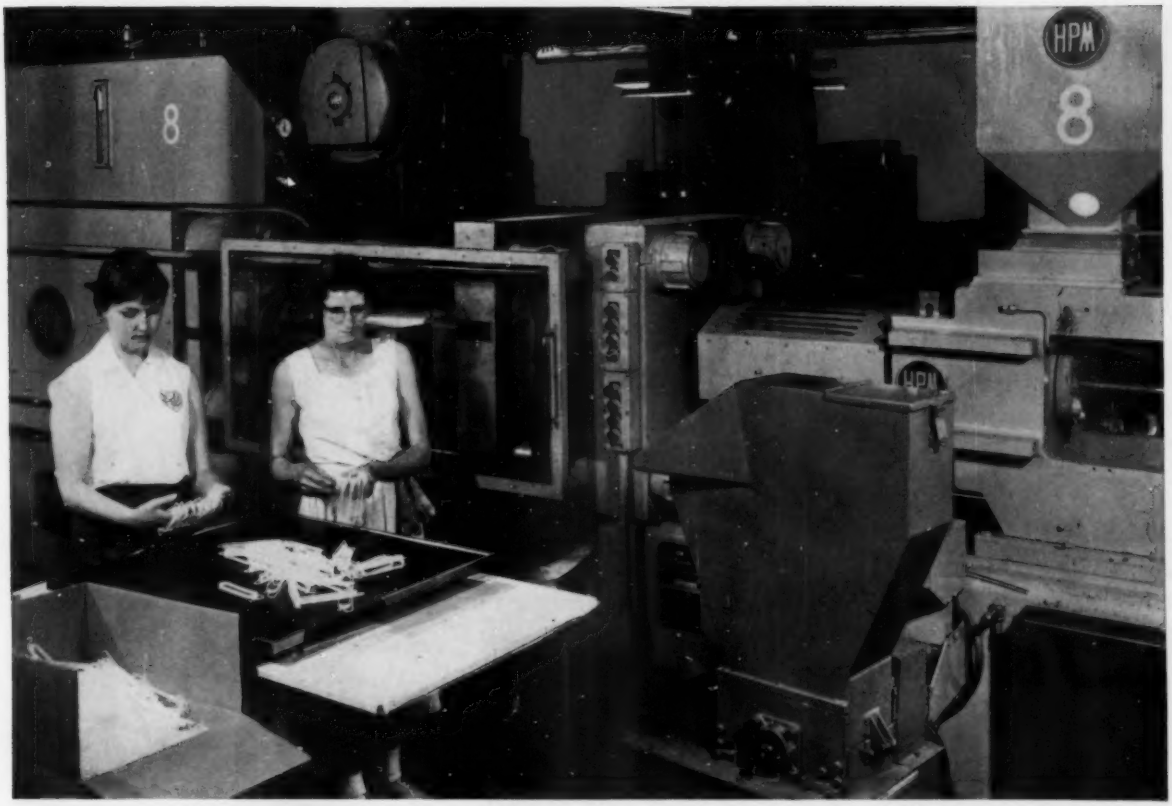
The honeycomb is an outstanding example of maximum use of available space . . . so are NRM's Pacemaker extruders, with Tuck-Under drive. Pacemakers, with motor and speed control located *under* the cylinder, save valuable floor space . . . allow you to increase production as much as 3½ times without capital expenditure for additional extruder floor area. Find out how. Call, wire or write today and ask for Bulletin PM-100.

2204-A

NRM

NATIONAL RUBBER MACHINERY COMPANY

General Offices: 47 WEST EXCHANGE ST. • AKRON 8, OHIO



Dimensional tolerances and strength qualities are rigidly controlled on these polyethylene straps used for piasma bottles.

Walter Hidding, President
Blackhawk Molding Co., Inc.
Addison, Illinois

"We have preferred to specialize in difficult molding jobs such as pharmaceuticals. This specialization brings us a lot of work which demands very close tolerances from both a dimensional and clarity standpoint. We've found H-P-M injection machines unsurpassed for the type of versatility we need. We've installed five new H-P-Ms in the past 18 months."

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Progress in Plastics by
A MOLDER ON THE MOVE

H-P-M time, pressure and temperature controls are specifically designed for precision molding. The 12 oz. machine illustrated typifies the success molders report. It demonstrates why 150 lbs./hr. plasticizing capacity, 2150 cu. in./min. injection capacity, can produce precision parts like these — *4800 per hour to close dimensional tolerances.* This job is fully automatic.

Got a problem like this? Call your H-P-M man today.

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WITHOUT PREVIOUS SIZE SHAPE, VOLUME AND GEOGRAPHICAL RESTRICTIONS!

Loma Industries...

• • • stands alone in the Southwest with unmatched facilities to handle your product, component, and packaging needs, and can offer you the most modern materials, techniques, equipment, and engineering skill ever assembled under one roof!

Loma and *Only* Loma can offer you these six specialized processes:

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Presses capable of turning out anything in size from a small creamer to a refrigerator with unmatched precision and volume.

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A dramatic new thermo-fusion process that gives you custom molding of unlimited size and shape to meet your exact specifications ... even if your product is as big as a car. Loma is one of only five manufacturers licensed in the United States by Spencer Company to use this process ... combining high strength, low cost tooling, lightness in weight, acid resistance, maintenance elimination as well as initial savings.

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Precision facilities for packaging or product needs of irregular shape including "squeeze bottle" applications ... one ounce to 5 gallons. Regardless of your packaging problem, Loma's blowmolding service can help solve it.

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The ideal solution where bouyancy, insulation, shock absorption, protection, and lightness in weight are factors.

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Perfect for film, sheet, pipe, rod, and special shapes.

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A phone call or letter will bring a Loma sales engineer to your plant with complete information.

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(A full description of these services may be obtained by writing for Loma's booklet entitled: "*Your* Product-Plastic-and Loma")

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"JET STREAM" STYLING . . .

MIRRO
THE FINEST ALUMINUM

CREATES A NEW CONCEPT IN COOKWARE

. . . unique off-center handles molded with PLENCO

Housewives are taking a shine to Mirro's new "Jet Stream" line of pots and pans with *Easy-Over* covers that give a new lift to the cook. Their revolutionary design features comfort-contour, phenolic-molded handles placed where a handle really belongs—on the *side* of the cover instead of the top!

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Plenco's experience in satisfying the exacting requirements of industry is equally wide, exceptionally thorough. It may well include acquaintance with your own particular needs. We'd like the opportunity to talk with you about them.

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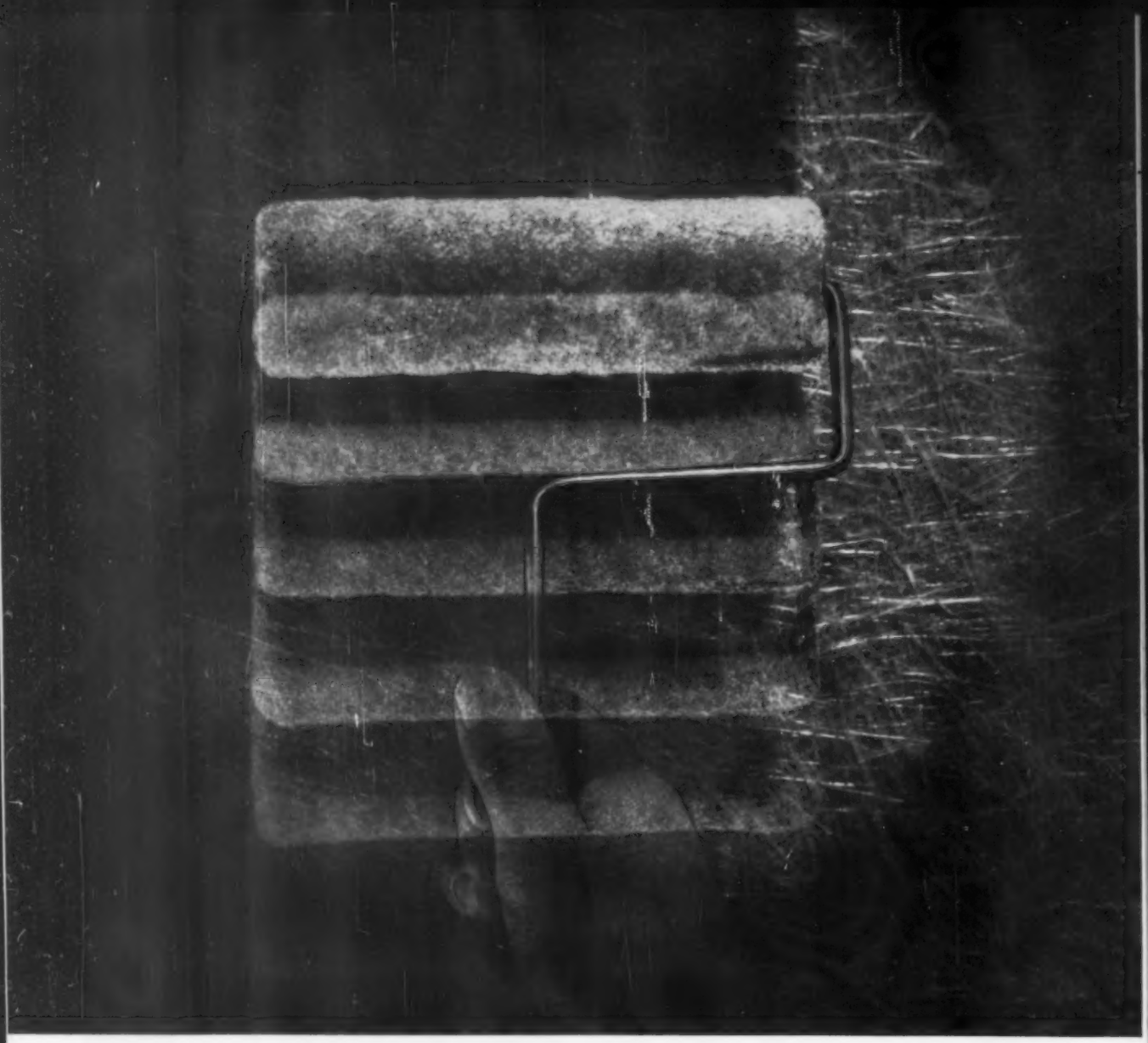
SERVING THE PLASTICS INDUSTRY IN THE MANUFACTURE OF HIGH GRADE PHENOLIC MOLDING COMPOUNDS, INDUSTRIAL RESINS AND COATING RESINS



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Layup time is reduced, wasteful flooding eliminated, production rates increased.

Faster wetting, rapid curing GLIDPOL layup resins make these dramatic savings possible wherever they are used in the reinforcement of plastic parts.

GLIDPOL layup resin systems are ideally suited to the manufacture of boats, bathtubs, sinks, swimming pools, truck bodies, panels, tanks and other products by the hand layup technique. Write for complete information on the resin system best designed to meet your particular requirements.

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RESINS FOR EVERY APPLICATION

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There's a GLIDPOL Polyester Resin system, plus Glidden Technical Service, to help you do it better, more economically, whatever your product, process or problem.

we'll make the press

YOU NAME THE MATERIAL CHARACTERISTICS

Just tell us the nature of the material—polyester, acrylic, fiber glass, rubber, or whatever—and give us your production specifications. We'll build the right compression molding press to meet your needs.

Erie Foundry regularly builds hydraulic molding presses in capacities of 25 to 4,000 tons. Our advanced design control systems will apply forces accurately and precisely, maintain platen temperatures within close tolerances, and perform molding cycles with split-second timing. Versatility is built in so that a wide range of molding jobs can be handled.

Write now for your copies of our descriptive bulletins on Erie Foundry hydraulic presses for rubber and plastics.

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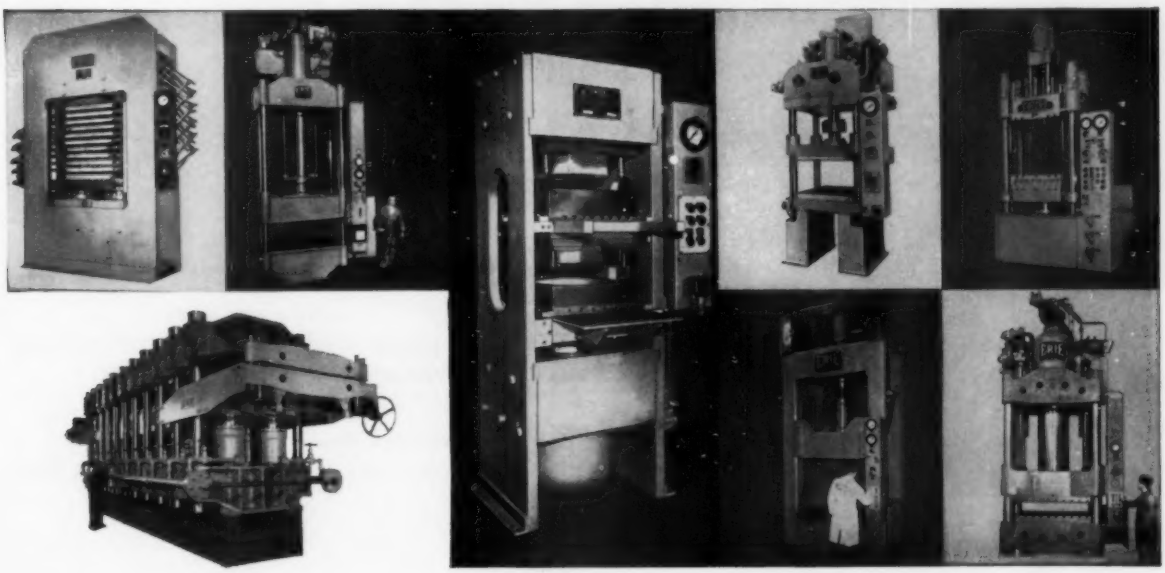


of equipment for

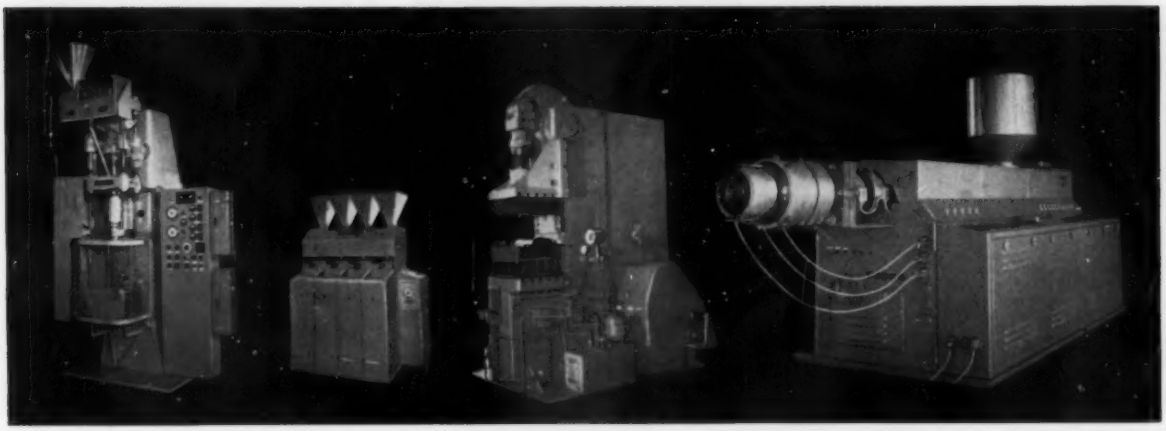
INJECTION MOLDING

COMPRESSION MOLDING

TRANSFER MOLDING

BLOW MOLDING

EXTRUSION



Blow Molding Machines with piston and screw feed up to 215 pts

Automatic Serial Presses for screw caps etc.

Compression and Transfer Molding Machines up to 300 tons capacity

Extruders and complete Automatic Plants (with screw diameters 1¼" 1¾" 2½" 3½" and 6" approx)

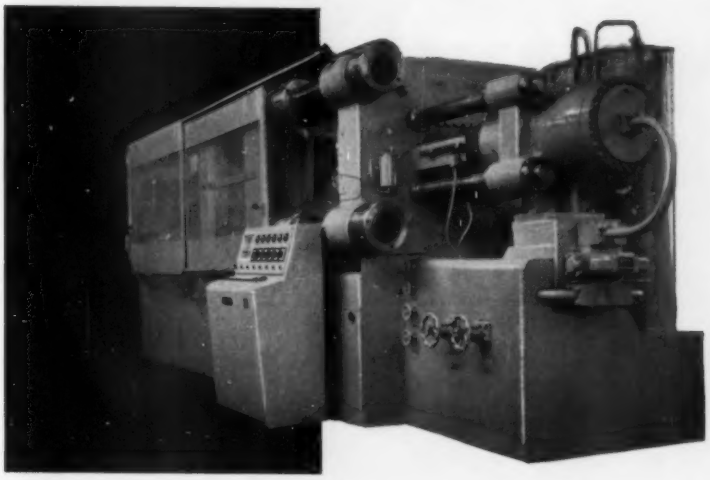
INJECTION MOLDING MACHINES

from 1/10 oz. upwards

with

SCREW PLASTICIZING UNIT

from 1 – 350 OZS



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ELECTRIC STRIP HEATERS

QUICK, LOW-COST SOLUTION TO PRODUCTION HEATING PROBLEMS

For heating tanks, kettles, pipes, platens, dies, ovens . . . just about anything. Chromalox Electric Strip Heaters provide uniform heat to exact temperatures.

Heaters available in shapes, sizes and wattages to fit hundreds of industrial heating needs . . . including yours. Installation is quick and easy . . . using standard bolts or clamps. Heaters give long service with little or no maintenance. Temperatures are maintained by either manual or automatic controls.

Write for Bulletin PA100. Or, for fast action and on-the-job assistance with your heating problems, call your Chromalox Sales Engineering Representative listed below. 32910

Embossing press converted to electric heat.

Hopper, to cylinder, to nozzle . . . Strip Heaters are easily applied to straight or curved surfaces.

Bending plastic sheets between 2 Strip Heaters.

Two heater groups, separately controlled for zoned heat.

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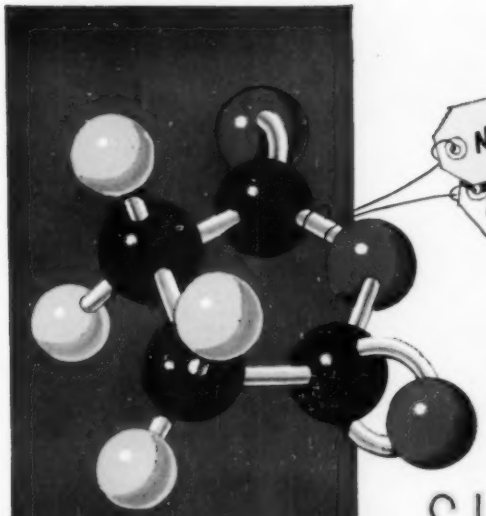
NASHVILLE, TENN.
Cypress 2-7016
NEW YORK CITY, N.Y.
(See Bloomfield, N.J.)
OMAHA, NEB.
Atlantic 7600
PHILADELPHIA, PA.
(See Bala-Cynwyd, Pa.)
PITTSBURGH, PA.
Emerson 1-2900
PORTLAND, ORE.
Capitol 3-4197
RICHMOND, VA.
Atlantic 8-8758
ROCHESTER, N.Y.
Hamilton 6-2070
ST. LOUIS, MO.
Chestnut 1-2433
SAN FRANCISCO, CALIF.
Underhill 1-3527
SEATTLE, WASH.
Main 4-7297
SOUTHFIELD, MICH.
Kenwood 8-2100
Elgin 7-0677
SYRACUSE, N.Y.
Granite 4-3933
WICHITA, KAN.
Amherst 2-5647



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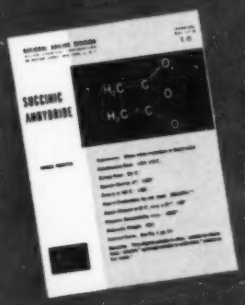

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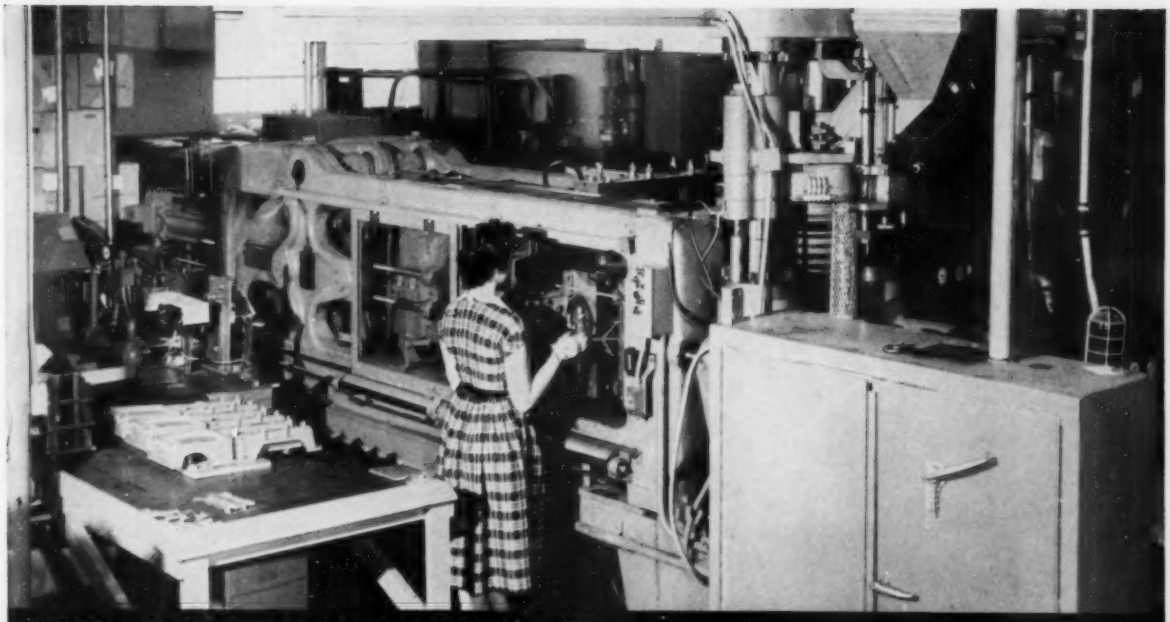


"On this quality truck body

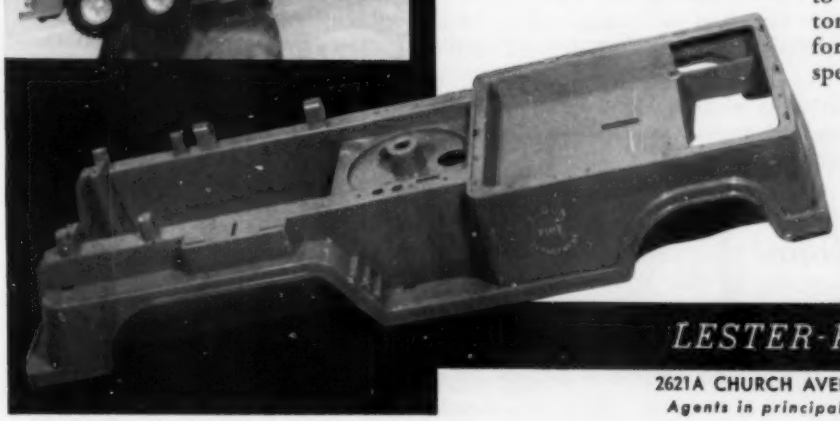
The 24/32 Oz. LESTER gives us 33% more production than we expected!"

"The new long-stroke 24/32-ounce Lester in our shop is molding this toy truck body 33% faster than the mold was planned for," says R. E. Roper of Delkay Plastics Corp. in Gardena, Calif.

It's a big part, weighing 22½ ounces of linear polyethylene—including the sprue and runners—in a 3-plate mold. The projected area is 216 sq. ins. with wall sections ranging from .062" to .125"... a tough job to fill and run steadily. Yet the Lester L-450-24/32 ounce machine takes it in stride and makes it a profitable job.

As an added bonus, the patented Lester Mold Overload Compensator (two pressure molding system) reduced the weight of the part by more than ½ ounce, and reduced strain at the same time—important to the durability of this "sit-on" toy.

The 24/32 ounce Lester, with its adjustable mold stroke of 8" to 30" and certified clamp of 450 tons can handle those big jobs for you, too. Write for detailed specifications.



L LESTER ENGINEERING CO CLEVELAND, OHIO 25th ANNIVERSARY

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SAFETY FIRST These line guards postformed and fabricated by A. B. Chance Company from a Formica laminated plastic provide great safety for linemen and save considerable maintenance time for the Hartford Electric Light Company. Maintenance of high-voltage transmission lines formerly required the tedious erection of temporary arms and insulators to clear the work area of dangerous hot lines. Now, maintenance crews need only to cover the exposed wires and insulators with the hoods prior to maintenance. The laminated plastics used in these line guards provide adequate insulation against extremely high voltages and are light enough to enable the hoods to be installed quickly, without fatigue. One of the important components used in this Formica laminated plastic from which the line guards were postformed and fabricated is Mount Vernon Duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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Same High Quality Material Once Sold For 32½¢ A Pound
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Why take chances on scrap or sub-standard materials now that these 3 standard grades of Spencer "Poly-Eth" molding resins are priced so low? With these resins you get the same fine Spencer service and product guarantee.

The new low price permits you to become more competitive in a wide range of molding markets. All three resins in the 26¢ "Poly-Eth" group are designed for a complete range of injection molding uses, as well as for blow molding of toys and novelties.

We invite you to sample one of these "Poly-Eth" resins without cost or obligation. Just contact your Spencer Representative or write directly to the address below:

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Resin number	Melt index	Density
"POLY-ETH" 1007	8	.918
"POLY-ETH" 1407	8	.925
"POLY-ETH" 1707*	8	.928

*Latest addition to the Spencer "Poly-Eth" family of molding resins.

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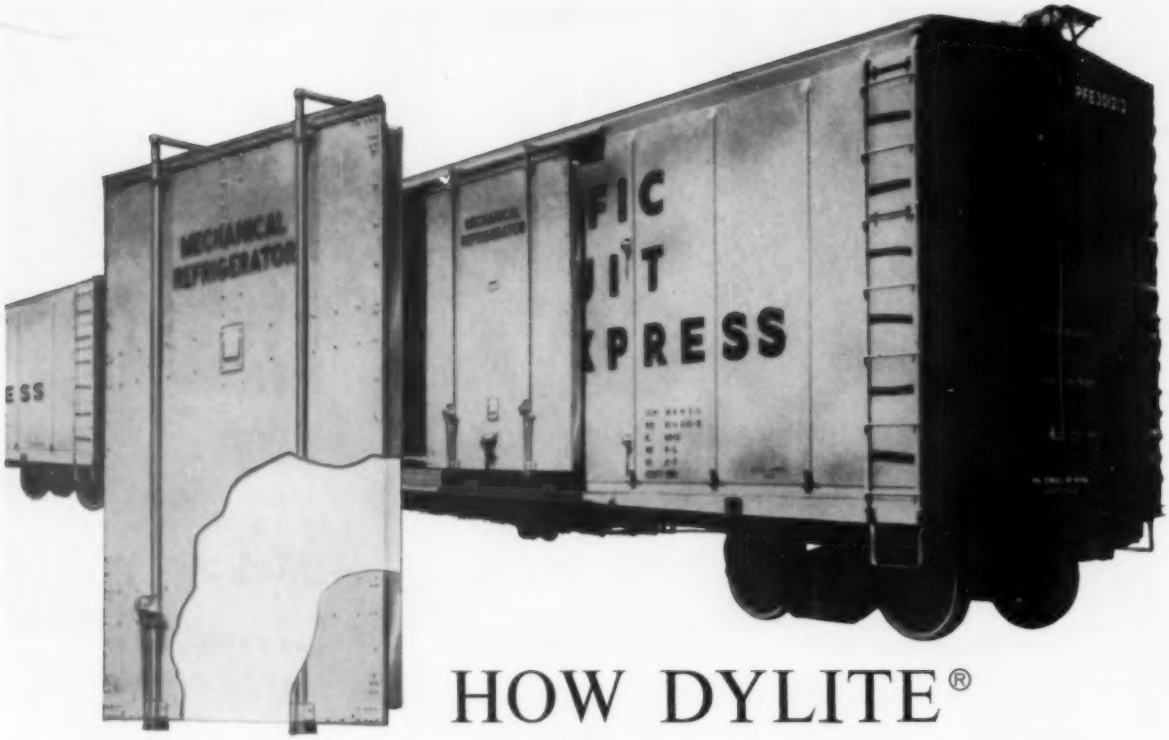

HOW DYLITE® GOT ITS FOOT IN A FREIGHT CAR DOOR!

This unique refrigerated freight car door is insulated with DYLITE expandable polystyrene. This lightweight foamed plastic forms a tight, moisture-proof, non-sagging insulation. DYLITE freight car doors improve insulation and weigh 400 to 500 pounds per car set less than conventionally-insulated doors. These doors are now being installed on 1,025 new refrigerated freight cars of the Pacific Fruit Express Company. The cars are temperature-controlled from –10°F to 70°F.

The door liner is molded of CYCOLAC* ABS plastic made by the Marbon Chemical Division of Borg-Warner Corporation. The idea to combine DYLITE with CYCOLAC came from Robert L. Landis, developer and manufacturer of the new door liners which are now manufactured by the Landis Industrial Company, Santa Clara, Calif.

DYLITE comes in the form of tiny crystal beads. When heated, these beads can expand up to 60 times their size and fuse; forming a light, smooth-skinned part at the desired density. DYLITE is a remarkable low temperature insulator having a K factor of 0.242 at 2 lbs./cu. ft. density and a 75°F mean temperature. It is low-cost, non-shrinking, and can be molded to almost any size or shape. In addition, DYLITE is strong, durable, moisture- and vapor-resistant.

For more information on the outstanding insulating qualities of DYLITE expandable polystyrene, write to Koppers Company, Inc., Plastics Division, Dept. MP100, Pittsburgh 19, Pa.

DYLENE® polystyrene, SUPER DYLAN® high density polyethylene, DYLAN® polyethylene, and EVENGLO® polystyrene are other fine plastics produced by Koppers Company, Inc.

**CYCOLAC is a registered trademark of Borg-Warner Corporation*

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Demaree Molds a 12½ oz. Styrene Urn Planter on their Natco 300.

"Our Natco Increased Production 25 to 50%!"

Says Mr. D. E. Demaree Sr., President of Demaree Molded Plastics

"And in addition to the production increase we have found the Natco much quieter with no vibration, cleaner with no messy oil leaks and more machine than others for its size."

Mr. Demaree, President of Demaree Molded Plastics, Inc., Kokomo, Indiana is very happy with their Natco 300. He further commented, "that Natco seems to have concentrated on a lot of little details which mean so much to an injection molder."

These little details can mean just as much to your molders too. Write for Bulletin 2001 for complete information on the Natco 12 to 80 ounce Injection Molding Machines.

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THE MOLDER'S MOLDING MACHINE

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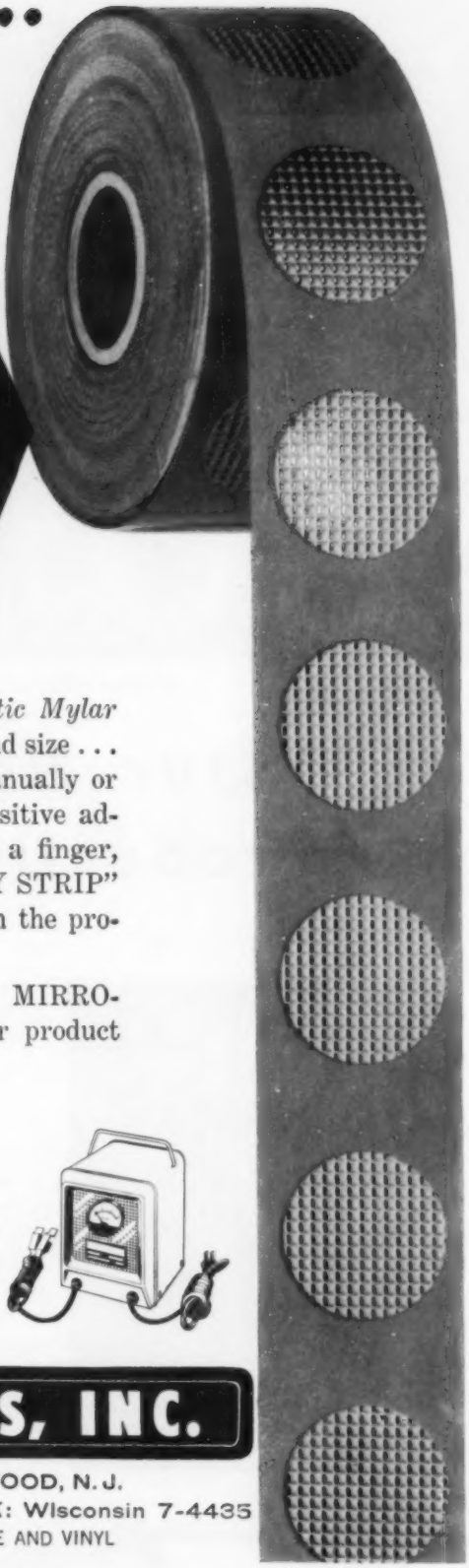

* *Decorative, metallized, self-sticking, plastic Mylar trims*, pre-cut to your exact shape, form and size . . . in continuous rolls! Simple to peel off manually or mechanically, backed with a pressure sensitive adhesive, ready to apply with the touch of a finger, with all waste material removed. "READY STRIP" can be one of your biggest time savers on the production line.

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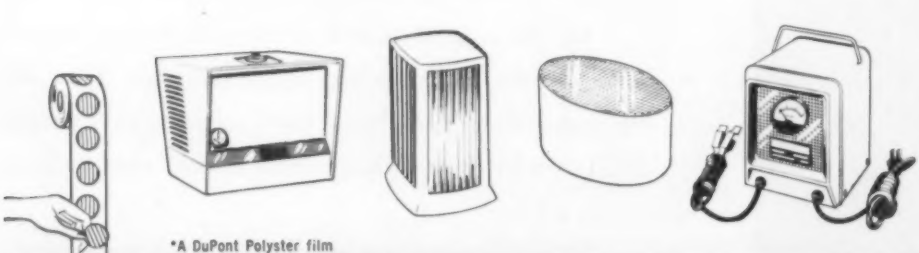

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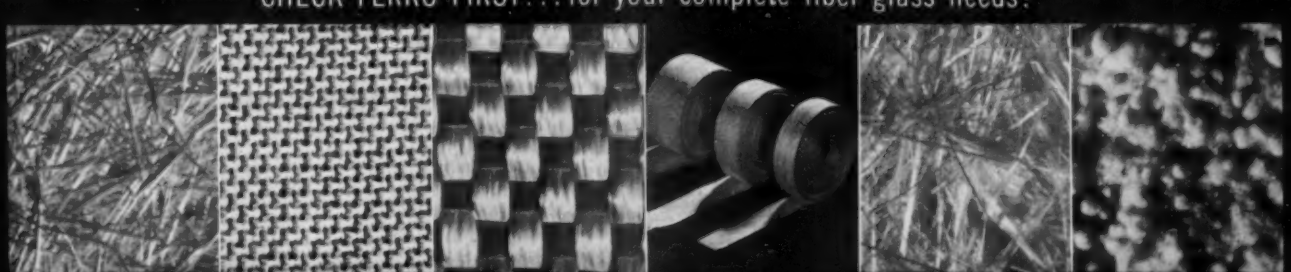

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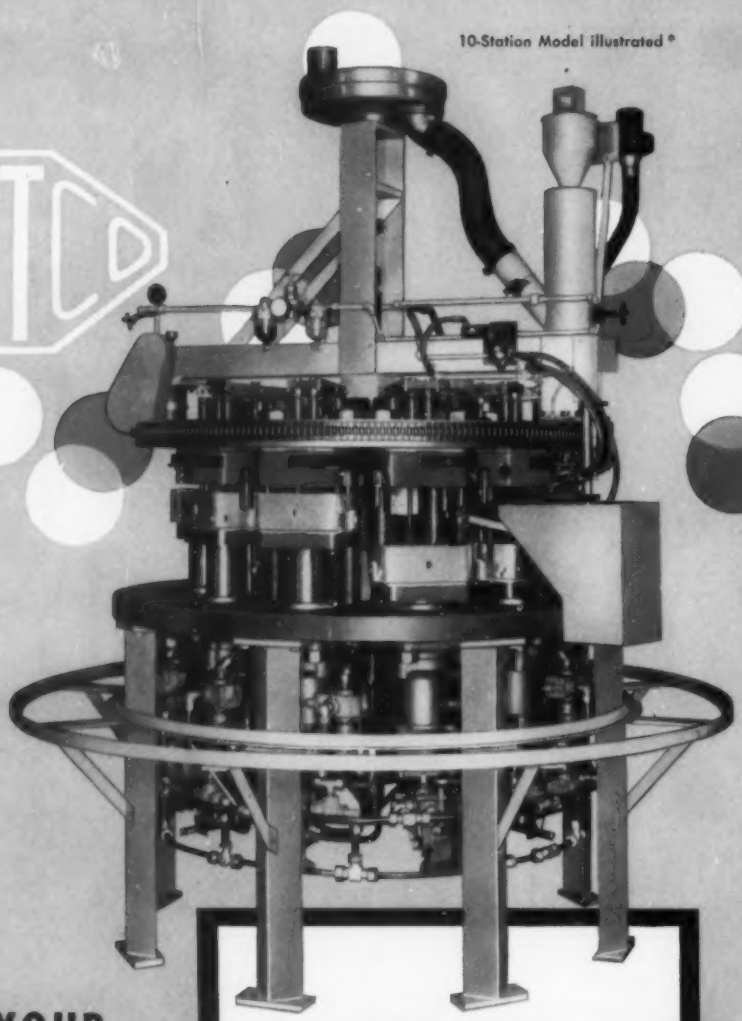
NEBUTTCO

10-Station Model illustrated *



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Press is also made in 30-station model.

THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 1 — **October 1960**

Expansion for polyethylene coating resin. Various producers assert that the recent price reduction to 27½¢ for polyethylene will tend to expand the market for coating grade resin proportionately more than any other section of the polyethylene business.

The resin price for coating material is also likely to be more stable, because it is less affected by the great quantities of off-grade material on the market. It is almost imperative that a first grade resin be used; and there is no usable scrap generated from a coating operation, since the resin cannot be efficiently reclaimed from its substrate. On the other hand, there is still some question about the price firmness of general purpose resin for film and molding grades at 27½¢, since there is so much off-grade around at lower prices.

Growth expected in future. The amount of resin used for extrusion coating on paper, foil, and cellophane is estimated to have been between 45 and 50 million lb. in 1959. There is as yet no indication that it will jump far over that mark in 1960. But it may reach between 50 and 55 million. Several months, maybe a year, will be required to take major advantage of a price decline.

A 5¢/lb. decline in coated paper prices followed rather generally after the resin price drop. Foil coaters also followed suit as indicated by Reynolds Metals' 7 to 10% reduction in various laminates with foil and paper. The company had doubled sales of these materials in the 12-month period ending last June, and is now completing a 300% expansion of its capacity. By the end of this year, the company will have five machines, four of which can extrude 2.5 to 3.0 million yd. of polyethylene per month and simultaneously laminate it to aluminum foil and paper. Among uses claimed for this product: packages for dehydrated foods and pouches for boil-in-bag frozen foods.

Coating machine expansion. The sale of extrusion coating machine equipment has doubled this year over last year, according to a leading manufacturer. The new equipment has been divided about equally between that for paper and that for foil and cellophane. A trend to wider widths is also on the way.

Interesting forecasts are being made about the future for this type equipment. Claims are made that extrusion coaters can now be run at a web speed from 350 to 850 ft./min., although the latter speed is seldom if ever achieved. The dream is that someday a machine will be put on the end of a paper machine and run at 1500 ft./min. but it will certainly need some fancy automatic handling equipment not now available. A 16-in. extruder that will coat simultaneously on both sides and maybe handle 5000 lb. of resin an hour is the goal. Present 4½- and 6-in. extruders can handle from 250 to over 700 lb. an hour, according to thickness of the film, say machinery producers.

The faster machines are aimed particularly at multiwall bag paper-PE laminates and milk cartons. Such equipment may help (To page 41)

*Reg. U. S. Pat. Off.

Announcing the SECOND Bachner Award COMPETITION

for outstanding achievement in the use of plastics

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The Bachner Award is conferred for excellence in the practical application of molded and formed plastic materials to the products of industry.

The Award was established in 1957 by the CHICAGO MOLDED PRODUCTS CORPORATION. It was named to honor the Company's founders for their contributions to the progress of the plastics industry.

The company winning the Second Bachner Award Competition will receive the trophy, suitably inscribed, and the individual(s) designated by the company as being most responsible for the achievement will receive $1,000. There is also provision for Honorable Mention Citations. Entries must be received by March 6, 1961. Awards will be made at the time of the National Plastics Exposition in New York in June 1961.

Complete information and entry forms are obtainable from the Secretary to the Committee, Mr. William T. Cruse, c/o Society of the Plastics Industry, Inc., 250 Park Avenue, New York 17, N.Y.

THE BACHNER AWARD COMMITTEE

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THE PLASTISCOPE

(*Continued from page 39*)

to replace asphalt impregnated papers in bags. Asphalt is only 8 to 10¢/lb. but more is required per lb. of paper. One paper producer has already stated that a polyethylene coating on paper that will perform as well as asphalt is already economically possible at the current PE price of 27½¢ for resin, but no one believes the asphalt people will quietly succumb to this price challenge.

The history of PE coating on paper has many facets. Paper manufacturers themselves have been the largest purchasers of machines to do the job. In the mid-50's they went overboard on buying equipment and then for one reason or another let a good part of it stand idle. Less than 20 million lb. of resin was used for extrusion coated paper in those days. Price of resin was claimed to be a major deterrent. But since that time resin has dropped from 41¢ to the new 27½¢ price and this plus know-how and improved machinery has aroused interest—a 100 million lb. goal within two or three years for paper coating resin alone is now considered probable.

Coating grade resins. Although a film-grade resin is occasionally used for coating, the most often used is a specially prepared material that is apparently more difficult to manufacture than general-purpose material.

The most commonly used resins are from 0.923 to 0.927 or 0.928 density. High-pressure resins in the 0.930 to 0.938 density range are marketed, but they cost more and are used sparingly. Union Carbide Plastics has advertised a high-pressure linear resin for coating multiwall bag papers with a thin ½ mil layer which makes it as economical as a thicker 1 or ¾ mil layer of regular PE, but it is possible that the new price on regular resin will cancel out that advantage.

As between 0.923 and 0.928 density resins, the former is used primarily because it runs faster. It also gives better heat sealability or adhesion. The 0.928 is used for improved barrier resistance—particularly grease and moisture. Coatings can be almost any thickness, depending upon the need—the small sugar pouches in restaurants are coated with a ¼-mil film which is used as the sealant. This job requires 4 to 4½ lb. of resin per ream of paper—14.4 lb. will coat a ream of paper with a 1-mil coating. Most milk containers now being coated with polyethylene use a low density resin, but may switch to 0.927 or 0.928 to be more certain of preventing leaks.

The coating on foil and cellophane serves as a sealant and in the case of foil supports it at the creases and covers any possible rupture. On cellophane it gives additional moisture resistance. From 5 to 8 million lb. of resin is believed to have been used for coating cellophane in 1959.

A potent remark by a PE producer on cost of coating resins is pertinent in predicting future trends for the coating market. Said he—"The material you coat on is now often more expensive than the resin—the cost of PE becomes less and less important in these applications as the price declines."

Coating with low-molecular-weight polyethylene. Another type of polyethylene used for coating is the low molecular weight or so-called polyethylene wax materials. Price of these materials, which has ranged all over the lot for various formulations, was reduced immediately following the drop in regular PE and is now the same, 27½ cents. This is the type that has been (To page 43)

J. Neipris, President, The Blane Corporation
Canton, Mass.

Blane Corporation President says,

"We get top quality and excellent service with VYGEN®

"We can't take a chance on resin variations," says Joe Neipris, Blane Corp. President. "We manufacture specification PVC compounds for the wire and cable industry and get consistently good electrical properties with Vygen 120. In our Custom Compound Division we specify Vygen 85 for molding compounds and Vygen 105 in 'Clears' because of its superior clarity. General's Chemical Division, in cooperation with our own Technical Staff, has helped in the development of a range of dependable PVC Compounds for the Wire and Cable Industry, for molding and for profile extrusions. For top quality and fast service, we count on Vygen."

This is only one of the many examples of Vygen's quality, service, uniformity and dependability. If you use PVC resin for extrusion, molding or calendering, write for details on Vygen, industry's finest family of specialized resins.

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Creating Progress Through Chemistry

Chemical Division GENERAL

THE PLASTISCOPE

(*Continued from page 41*)

used at about 2% of volume with wax in wax-paper bread wraps for a long time. It is also used for hot-melt coating, waxes, polishes, and as a blend with regular PE to promote flow in the mold. From 25 to 30 million lb. of polyethylene is estimated to have been used in 1959 for this purpose.

This type material attracted particular attention at the last Packaging Show when Eastman Chemical exhibited a Steinemann curtain coater which makes it possible to apply an extremely thin coat of PE on various types of paper. It is useful for cut sheets like those used in set-up boxes and corrugated containers. There would be no waste since the paper is cut before the box is assembled and there is no coated scrap such as ends and corners that can be repulped. Six of these machines have now been delivered in the U. S. They use various formulations from 2 to 20% or more polyethylene with wax. In addition to pre-cut boxboard this coating could be used for frozen food packages, milk cartons, etc. Other possibilities: a 24-bottle beer case, and a lettuce case in which ice is part of the content.

This is said to be a new concept in hot melt coating since it consists of simply pouring a curtain of coating material and passing the substrate through it. Emulsion coating has long presented a viscosity problem because of drying difficulties and it didn't always penetrate as much as desirable. The hot melt coating is a middle area between emulsion and extrusion coating. Eastman Chemical thinks the Steinemann coater will help solve the hot melt problem and result in large sales of low-molecular weight polyethylene.

Vinyl chloride expansion. Goodyear is now ready to go on stream with part of its 20 million lb. polyvinyl chloride expansion at Niagara Falls. This event calls attention to an industry that soon will have a capacity somewhere between 2.3 to 2.4 billion lb. and probably won't consume much more than 900 million lb. in 1959.

This overcapacity undoubtedly has influenced the 1960 decline in prices. A year ago, general-purpose (mostly calendering and extrusion) was 23½ cents. In May 1960 it dropped to 22 and in September fell to 20½ cents. This time, in contrast to the "olden days," the specialties fell off too to bring them close to general-purpose. Plastisol resin is now 24¢, rigid copolymer for flooring is now 21½, and the record grade 23½ cents. Compound prices have dropped 2 to 5¢/lb. Foreign imports, too, may have contributed to the decline —less than 20 million lb. is brought in, but there would be more if the domestic price were higher.

The present Goodyear expansion pertains only to their dispersion or plastisol resins—Pliovic WO and Pliovic AO. Up to now these resins had been on allocation and, according to Goodyear, are different from any other dispersion resins. WO is claimed to have better thixotropic viscosity—it has low viscosity but spreads better under the knife and "builds up" after it passes the knife. In molding it gels at an unusually low temperature. AO is said to be notable for low temperature fusion—takes less heat or less time.

Another item by Goodyear is vinyl shoe heels for girls' and women's "flatties." The resin is plasticized but is semi-rigid and is not affected by cold weather. Most molders buy this material from compounders, but Goodyear does its own compounding. It is claimed that the (To page 45)

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THE PLASTISCOPE

(*Continued from page 43*)

cost of this heel is less than those made from leather and fiber board since there are no trimming and finishing operations, but that they will wear better.

Possibilities for polyvinyl alcohol. Here is a resin that has been around since 1939, when it was commercialized by Du Pont at $1.25/lb. It now sells at from 57 to 83¢/lb. and Du Pont has at least 8 different grades. However, consumption is estimated at from only 20 to 25 million lb./yr., and production capacity will soon be 60 million lb. Producers in addition to Du Pont are Shawinigan, Air Reduction, Borden, and American Aniline. Colton Chemical, a subsidiary of Air Reduction, also has a 2 million lb. plant for production of special grades of this resin.

Present interest has been stimulated by several events. The new 20 million lb. Air Reduction plant is about ready for commercial production. The big soap companies are reportedly about ready to announce use of water soluble PVA film bags as containers for detergents and bleaches. The two PVA film producers are expanding. Reynolds Metals is adding two new casting lines for PVA film to its plant in Grottoes, Va., and Mono-Sol in Gary, Ind. has reportedly doubled its capacity. Lestoil Inc. is packaging its "Lestare" bleach powder in PVA, and Techno-Economic Service is packaging its "Toss" detergent in PVA bags, based on Borden's resin.

Largest single use for PVA today is about 10 million lb. used annually for adhesives—a stiff price reduction in price of resin could add a greatly increased volume use for this purpose. The Japanese use it as a fiber for fish nets and various types of fabric. Other uses are in film, polyvinyl butyral, textiles, and paper treatment.

What about PVA soluble film? A film bag containing a measured volume of ingredients that will dissolve when thrown into a tub or bucket of cold water obviously has advantages when the user is handling detergents, bleaches, dyes, insecticides, and "difficult to handle" chemicals. The potential market for this type of soluble film for detergents and bleaches is estimated at from 20 to 60 million lb./yr.

An attempt at this sort of thing was tried 7 or 8 years ago by bluing producers but it was not widely adopted. One of the complaints offered by critics was that the dissolved bag left a gooey residue. But this complaint is not a problem, according to Borden Co. officials who assert that their new PVA resin, called Lemoflex, will make film that has complete and instantaneous solubility. The earlier soluble PVA films contained glycerin as a plasticizer in order to obtain flexibility and it migrated when the film was stored thus leaving a brittle film. Borden has developed a method for internally plasticizing its resin so that there is nothing to migrate. This special grade of resin from which current dissolvable PVA film is being produced sells for 85¢ compared to regular PVA at 57¢ but the film producers are taking it at a rapid clip. No other PVA resin producer has yet come up with a similar product but they are all working at it and expect to have a similar material within a reasonably short time.

For additional and more detailed news see Section 2, starting on p. 212

LETTERS TO MODERN PLASTICS

Where readers may voice their opinions on any phase of the plastics industries. The editors take no responsibility for opinions expressed.

For better RP boats

Sir: We were glad to see your editorial on standards for RP boats in the May 1960 issue, although modestly placed on the last page. There seems to be no way to settle on a minimum hull thickness or stiffening, due to the multitude of designs and improvements in methods of construction and materials.

We agree that seaworthiness tests offer the final word and look for means of encouraging all producers of boats to submit to a standard test. It is encouraging to see what is going on down on Siesta Key near Sarasota, Fla., where Mercury has its testing grounds. A great many producers of boats are waiting in line to get a report on their boat under outboard power up to twin 75-hp. motors.

Mercury gives a full report on every boat tested, which is sent to each dealer who can then give to each customer exact data needed in determining the correct motor, prop pitch, most efficient motor angle, etc. for his boat. On the other hand, the boat producer is assured of a predetermined performance at no cost to himself, which he can use in selling his product.

We have seen several boats (particularly catamarans) which have been improved as a result of these tests, before the boat was offered for sale. This sounds like a big step in encouraging tests as described in your editorial, and a painless one at that. Perhaps some of the other manufacturers of power equipment can be induced to participate in a cooperative program.

L. M. Russell

Glascoat
Miami, Fla.

Sir: I was particularly impressed by your editorial "About standards for RP boats" in the May 1960 issue. As you have stated on several occasions "somebody is going to get hurt—maybe our entire industry."

Last year we negotiated a large prime contract with USAF for equipment to build a polyurethane radome. As part of the contract, we were required to perform many environmental tests on large equipment. This necessity, together with a previous desire to build an environmental chamber, led us unhesitatingly into the construction of a very large and unique unit. The chamber was built with a crash program and $237,000 and was completed in February 1960.

There was considerable unsolicited publicity in the Midwest and before we knew what was occurring, we had more requests to rent the services of the chamber than we could possibly accommodate. Many of these requests come from firms with some form of defense contract. However, surprisingly enough, there are a good percentage who want reliability testing on their regular commercial items.

Although the chamber has been in operation for approximately three months, we have had some very disturbing as well as gratifying results. As an example, in the boat industry, many manufacturers sell boats to dealers in the fall of the year. These boats are stored (as a rule) outdoors during the winter, with no climatic protection. In the northern part of the U.S. the temperatures can fall to —40° F. or even lower; and then there's a warm-up. What effect does this have on the boat? On a particular test which we ran on an RP boat, with the environmental conditions simulating those described above, large cracks developed on the bottom and sides of the hull. When the manufacturer discovered this phenomenon, he used a more flexible resin and the same test was quite satisfactory, erasing a burden from his mind and possibly a catastrophe with an ultimate user.

Here are the environmental chamber capabilities:

Maximum temperature	185° F.
Minimum temperature	—125° F.
Maximum humidity	99% plus
Minimum humidity	3%
Maximum altitude	50 miles
Rain per hr.	3 in.

The chamber is capable of producing solar radiation, ozone, vibration, acoustic excitation, ionization, and other stratospheric conditions. All tests are accomplished without the necessity of equipment removal from one series to another. The room size is 17 ft. long, 13 ft. wide with a 9-ft. ceiling. The largest door is 9½ ft. wide by 9 ft. high.

I believe this letter will graphically illustrate to all concerned that the government is not the only one who should check for reliability. We all need to know.

W. B. Resnick, Pres.

Mol-Rez Division
American Petrochemical Corp.
Minneapolis, Minn.

The U.S. injection machine lag

Sir: The evolution of injection molding techniques that I have observed both here and abroad have caused me some concern regarding the state of American technology in this field. The illogical condition that finds European technology committed almost totally to the new screw plasticating technique, with its indisputable quality and economic advantage over the plunger machine; and, conversely, American machine makers' "head in the sand" attitude with their total commitment remaining with plunger type equipment, leaves me at a complete loss to understand the reasons.

It would be less puzzling if the screw plasticating system was a totally new concept without relationship to available industry knowledge. But in searching the evolution of the system I find that patents issued over 30 years ago in the United States to American companies disclosed all of the basic fundamentals of this method; and the theory had been reduced to practice experimentally and in limited production units for a great many years in America.

A long list of advantages relative to product quality and the economic implications of higher thruput as related to plasticating capacity far outweigh the somewhat higher costs of the unit and the requirements for higher skills in operation.

The only explanation that could be given to this divergence of basic direction would be that the overabundance of backlogs on existing equipment negated the necessity of a major design changeover with its relatively high development and tooling expenses.

Perhaps a good old-fashioned slump in plastic processing machinery sales and severe competition from abroad by the more advanced equipment will stimulate the Yankee ingenuity.

Martin Usab, Pres.

Dynatech Plastics Inc.
Santa Ana, Calif.

(Advertisement)

Draw one... rigid?

This is a story about FOAMS... urethane foams

EVERYONE KNOWS you can control the amount of foam on a stein of beer . . . that's easy. Controlling the action of poured urethane foam materials is also easily mastered.

But to spray foam on smooth or irregular surfaces on a commercial basis . . . that was another problem — a real problem.

So, while we were pioneering in polyether-based urethane foams, we had our business eye cocked for means of spray applying it. We discovered that a leading maker of spray-painting equipment was already alert to the great potential of urethane foams, and was more than anxious to cooperate.

Result: Solvent-blown polyether urethane spray foams became a reality. Standard, portable hot-spray catalyst equipment, which is readily available, makes the application of these new foams just as commercially practical as spraying paint.

Wherever you wish to apply urethane foams — for thermal insulation or sound dampening in freezers, refrigerators, industrial tanks and surfaces . . . in air-conditioning cabinets, ducts, or as a reinforcement for thin-gauge metal sections of aircraft and automobiles . . . or for corrosion control in industrial plants—you'll find the equipment and raw materials easily obtainable, and the results predictable.

For, it all goes back to the proved Wyandotte system: that when polyurethane components are simultaneously mixed and atomized in an air blast, foaming action takes place. This action begins immediately, even before the mass strikes the surface, and is completed in a matter of minutes.

Can you see the possibilities for profit? More than 1400 other firms and individuals have (according to inquiries received). But perhaps you're wondering, "How do I go about it to get the best results?" This will assist you:

1. If you are a prepolymer manufacturer, or are making foams for others, keep in close contact with our market-development and new-products departments.

2. If you have need for urethane foam to be applied in your plant, get in touch with a prepolymer maker or foam applicator.

3. If you make, or wish to make, urethane foams as a part of your own products or processing, write us direct, describing your requirements in as much detail as possible. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

Wyandotte's urethane-foam raw materials include: PLURACOL® Series of Triols, used for one-shot flexible foams and for the preparation of rigid urethane foams; PLURACOL Diols used for prepolymer-type flexible foams and to impart strength properties to one-shot flexible foams; TETRONIC® Polyols, for improved resilience and moldability; QUADROL®, a very reactive cross-linking agent and catalyst; DHP-MP, a catalyst with extremely low odor.

Wyandotte CHEMICALS

MICHIGAN ALKALI DIVISION

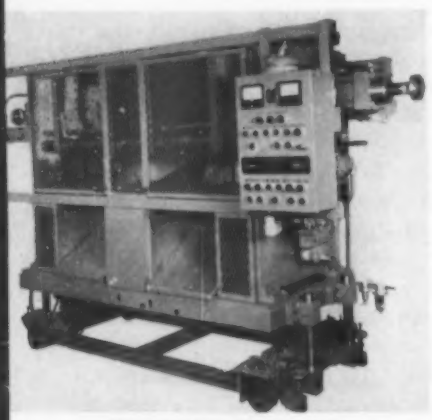
PACING PROGRESS WITH CREATIVE CHEMISTRY®

NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Blow molding machine

Designated Model 2424D-10, this two-station blow molding machine has a clamping force of 10 tons designed for low pressure pre-close prior to final closing. High pressure is not exerted until the last ⅛ in. of platen travel. Free platen area for mold mounting is 24 in. square.



WALDRON-HARTIG Model 2424D-10 two-station blow molding machine rests on four vertical adjustment columns mounted on a movable base. Extruder and accumulator parison manifold are not shown.

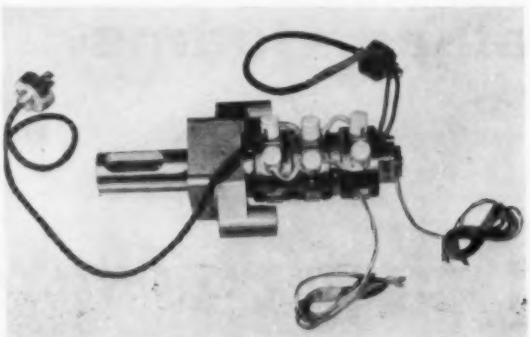
Daylight opening, with both stations closing simultaneously, is adjustable from 6 to 26 in., without simultaneous closing, 6 to 34 inches. Platens ride on four tie bars, 3 in. in diameter, and are actuated by eight 3¼-in. bore hydraulic cylinders. Entire press is mounted on tracks for lateral movement of 24 inches. The machine is also adjustable vertically ±6 in., and front to back, ±3 inches. This allows the unit to be adjusted to the parison nozzle and facilitates mold changes. The press can be run automatic, semi-automatic, or manually. A cooling water manifold with 12 connections is standard equipment. The mold unit is fed from a ram type accumulator designed for mounting on Waldron Hartig extruders. Weight of the accumulator shot is controlled by ram limiting device from 1 to 4¾ lb., and the approximate time for a complete cycle with a 4-lb. shot is 42 seconds. Nominal time for an injection stroke is 3 sec., but this will vary with operating temperature and material. Dies for tube diameters up to 15 in. are easily changed, as are breaker plates, without removing accumulator from extruder. Each of the two dies has a separate on-off valve allowing dies to operate alternately or simultaneously. Extruder may be operated continuously at its full rated output during the blow molding operation. The use of the ram/accumulator is said to assure excellent uniformity of temperature, size, and wall thickness of the parison. *Waldron-Hartig Div., Midland-Ross Corp., Box 791, New Brunswick, N. J.*

Large extruders

Particularly suited for large-volume production, these air cooled extruders are made with 6- and 8-in. diameter screws as standard equipment while 10- and 12-in. barrels are made to special order. All four sizes are available in vented or non-vented design, in L/D ratios of 20:1 and 24:1, and are similar to other of the company's machines except for being larger in size. All units are supplied with resistance-band or cast-in heaters. Extra heavy-duty thrust bearings, forged steel barrels, and precision ground screws are designed for heavy usage with a minimum of maintenance. *Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.*

Heating cylinder

A redesigned heating cylinder for Mini-jector plastic injection molding machines provides 50 to 100% greater heating capacity than previous cylinders for this line of machines. This unit will be standard equipment on both Eldorado models, the new Mini-matic, and the Super Hornet Mini-jector models. It will also be available on all other models at extra cost when used with pyrometer-type heat control. The new cylinder has a non-drool nozzle and interchangeable plunger sleeves to permit switching to these bore sizes: 1 1/16, ⅞, ¾, or ⅝ inch. *Newbury Industries Inc., Newbury, Ohio.*



NEWBURY replacement heating cylinder, for Eldorado, Mini-matic, and Super Hornet Mini-jector injection machines, has increased plasticating capacity.

Spray system

Called the CB-2015, this portable fibrous glass spraying unit, mounted on an easy-to-move trailer, will mix, circulate, control, and supply materials for chopped fiber spray guns, mixing devices, or two-part spray heads. This unit has Graco air-powered circulating pumps, a 60-gal. mixing tank set, a circulating hose and control system, and a "feather tip" folding boom that can support hoses, cords, and spray heads in all positions with a minimum of operator effort. This system is priced under $2,000. *Chrom-O-Lite Co., 2701 E. 78th St., Minneapolis 23, Minn.*

Welding torch

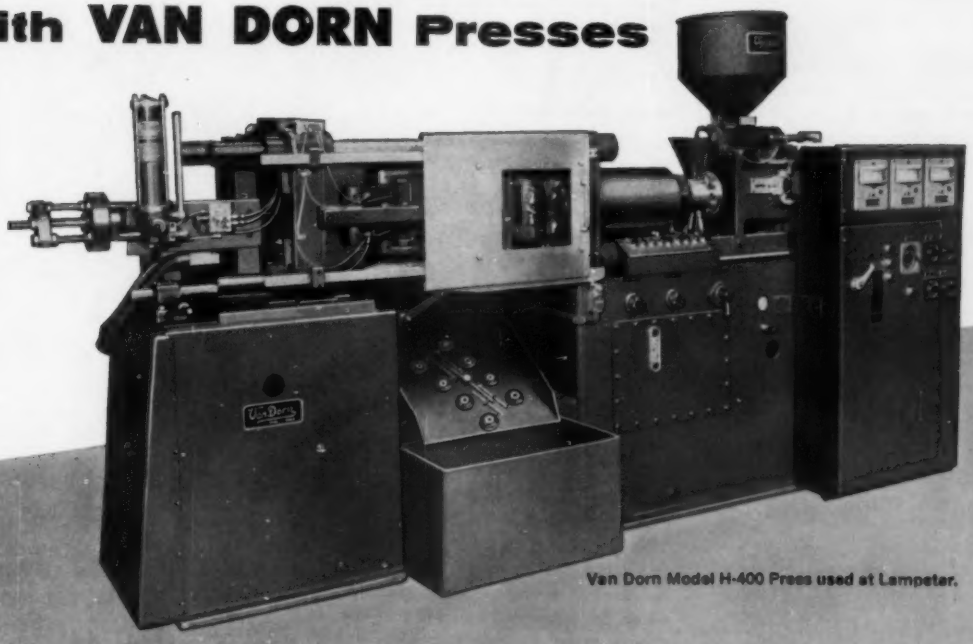
The #10-10 utility torch can be used for welding any thermoplastic. Weighing 9 oz., the 11-in.-long torch has a ceramic heating element for 110-v., 350-w. service. With a stainless steel body and top, the torch has a molded plastic for insulation handle. Also supplied are 12 ft. of vinyl hose, 15 ft. **(To page 50)**

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

Hubley Tic Toy Clock—many of the 40 parts are made on The Lampeter Manufacturing Company's Van Dorns.

tic tock, 'round the clock

AUTOMATION with VAN DORN Presses



Van Dorn Model H-400 Press used at Lampeter.

As a major supplier for The Hubley Manufacturing Company, a leading toy producer, The Lampeter Manufacturing Company is an extensive user of plastic machinery. Lampeter operates their fully automatic Van Dorn 4-6 oz. and Van Dorn 3 oz. presses *24 hours a day, six days per week.*

Besides a substantial reduction of cycle time, the company reports the Van Dorn presses are economical, versatile, and require minimum maintenance. The general manager says that if he buys more machines of the same size, Van Dorns would certainly be a top consideration.

You, too, can save time and money with Van Dorn high production injection presses. Write for detailed information.

Inspection of toy parts produced on the Van Dorn H-300.

Van Dorn

THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

NEW MACHINERY-EQUIPMENT

(From page 48)

of three-conductor electrical cable, and a spanner wrench. All equipment is packed in a metal carrying case. *Laramy Products Co., Box 8, Hingham, Mass.*

Heat sealers

Designed for continuous operation, the SP series of self contained high-frequency sealers has a fully filtered power supply and one-knob d.-c. power control. A special valve is provided for manually jogging the press platen to any position between open and locked. Safety equipment includes overload breaker switches on line and plate currents and service door interlock switches to cut off power when service doors are opened for maintenance. Additional specifications are included in the table shown below. *Weldotron Corp., 841 Frelinghuysen Ave., Newark 12, N. J.*

WELDOTRON Series SP heat sealing equipment incorporates double "V" gib slide construction for control of platen travel.

Hole detector

For the continuous inspection of films, this unit has sensors consisting of 6-in.-wide metal brushes which exert a pressure of about 4 g. each on the surface of the inspected sheet. The brushes contact the upper surface of the film as it passes over a grounded metal roll. Using several brushes adjacent to each other permits inspection of the entire width of any size sheet. The hole detector's brushes examine 100% of the running web width all of the time at speeds up to 2000 ft./min., and detect voids as small as 0.010 in. in diameter. The unit works on the principle of time-rate of contact. The brushes, the film, and the grounded roll serve as switch. Encountering a hole, brush bristles touch the grounded roll for just the time it takes the hole to pass under them. Upon contact, an electrical pulse is developed, whose duration is proportional to the size of the hole. An internal calibrator is preset for the maximum hole diameter permissible. Holes equal to or greater than the calibrated setting stop the web. The brushes are automatically and instantly lifted off the roll by pneumatic valves if there is a web break. *Curtiss-Wright Corp., Princeton Division, Princeton, N. J.*

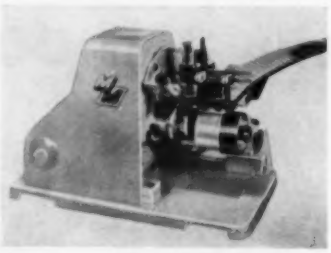
Specifications: Weldotron SP series of self contained high-frequency sealers

Model:	15SP	30SP	45SP	60SP	100SP
Power output, kw.	1.5[a]	3[a]	4.5[a]	6[b]	10[b]
Frequency range, mc.	25 to 30	25 to 30	25 to 30	25 to 30	20 to 25
Line current, amp.	15[c]	35[c]	50[c]	35[d]	60[d]
Cycle timer range, sec.					
Pre-heat timer	0 to 6	0 to 6	0 to 6	0 to 6	0 to 6
Heat timer	0 to 15	0 to 15	0 to 15	0 to 15	0 to 15
Dwell timer	0 to 15	0 to 15	0 to 15	0 to 15	0 to 15
Bed platen size, in.	18 by 24	18 by 24	20 by 30	20 by 30	30 by 40
Die mounting platen, in.	10 by 12	10 by 12	12 by 14	12 by 14	14 by 20
Press daylight, in.	8	8	8	8	10
Press stroke, in.	7	7	7	7	9
Maximum die force, lb.	925	925	1250	1250	2800

[a]Linear output controlled by powerstat on d.c. plate voltage. [b]Linear output with thyratron control on d.c. plate voltage. [c]220-v., single-phase, 60-cycle supply. [d]220-v., 3-phase, 60-cycle supply.

Part marker

Tapered objects of plastic can be marked at speeds up to 100/min. by Model 20A imprinting machine designed for completely automatic



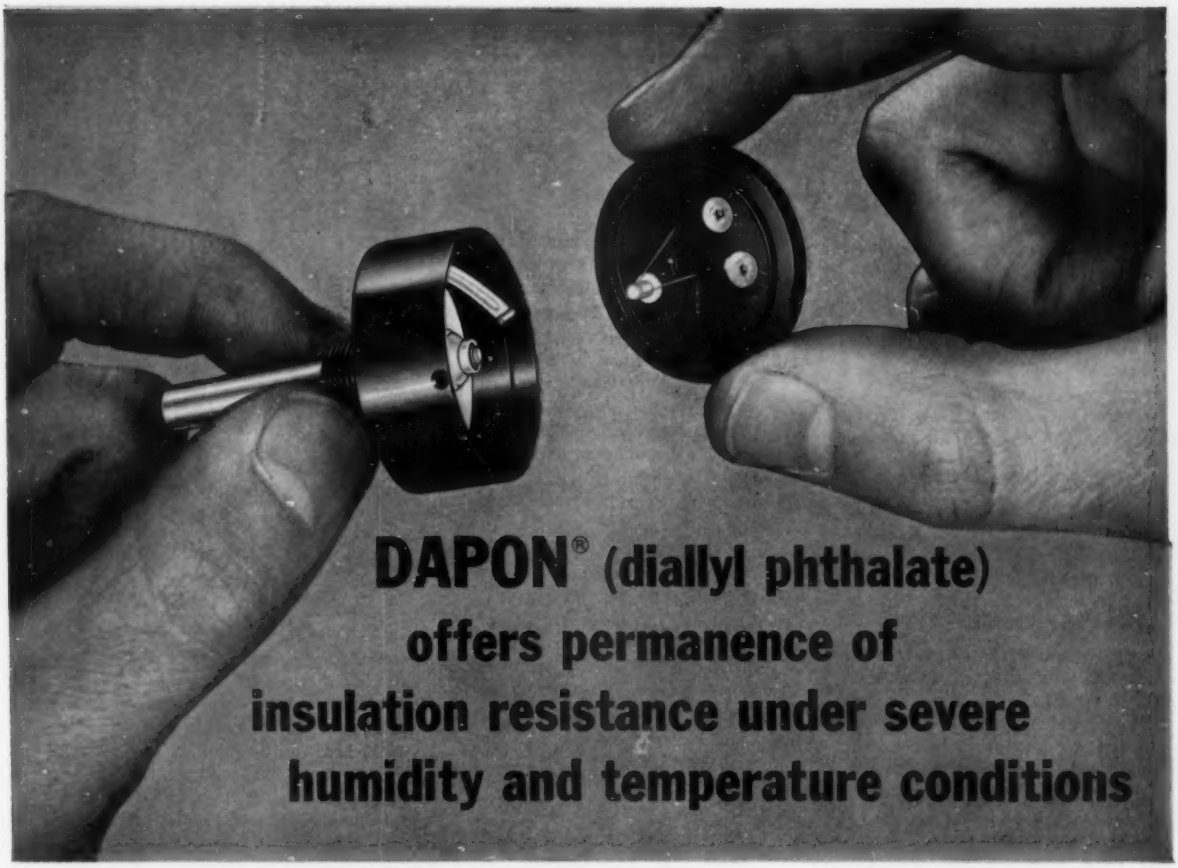
feeding, imprinting and part ejection. Objects up to 2¼ in. in major diameter are automatically fed from a curved chute magazine into the printing mechanism. The machine adjusts to objects of various sizes, and uses quick-change type inserts. Individual lot or control numbers, for example, may be inserted without changing the printing plate on the machine. Special inks for various applications are also available from the manufacturer. *Markem Machine Co., 150 Congress St., Keene 78, N. H.*

Tension control unit

Oscillating unwind and rewind units available in various sizes are made for handling webs from 4 in. to millrolls 84 in. wide; larger units may be custom-designed. Programmed oscillations, such as in de-puckering in plastics, are easily obtained, using a simple cam cut to any experimental shape, to guide the sensing head. The unwinds or rewinds may be equipped for automatic operation of edge-guiding, web centering, width recording, slitting attachments, measuring, and counting devices, etc. The units can also be used for handling of filament such as wire, ribbon, etc. *Web Controls Corp., 318 Briarcliffe Rd., W. Englewood, N. J.*

Bottle oven

Fully conveyorized and specifically engineered for drying and curing the labels and decorations on polyethylene and other plastic bottles, as well as epoxy inks on glass, the Thermo-Jet oven accurately controls belt speed and oven temperature. Units are designed to be used as post printing take-off equipment in conjunction with **(To page 52)**



DAPON® (diallyl phthalate) offers permanence of insulation resistance under severe humidity and temperature conditions

This plastic is ideal for applications where changes in humidity can affect electrical values. DAPON can prevent costly "in service" failures in electrical and electronic components.

A new molded plastic potentiometer produced by New England Instrument Company features exceptional resistance to humidity, high reliability and low noise. A raised conductive plastic ring is used in place of resistance wire in these miniature units. The new potentiometers are ideal for servo and instrumentation applications where long life and extreme accuracy are important factors.

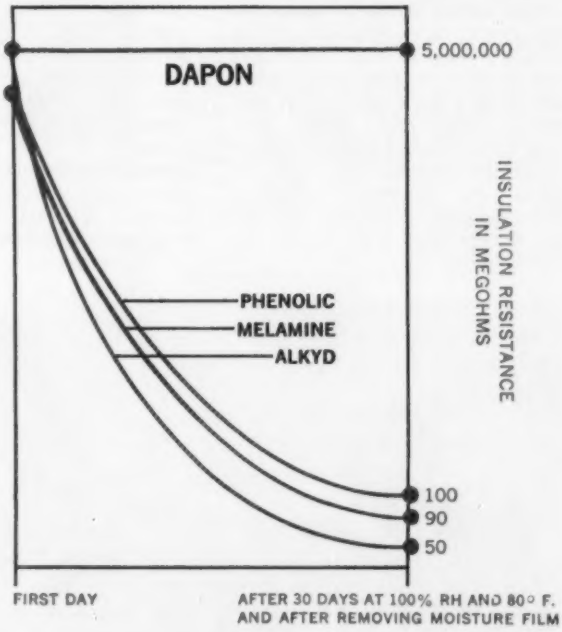
The solid resistance element, insulating base and silver terminal leads are molded in one operation with DAPON (diallyl phthalate) Resin. Result: a single, almost indestructible precision unit.

New England Instrument chose DAPON because of its superior electrical and physical properties, and its low moisture absorption. DAPON also molds easily around metal inserts without cracking, and withstands extremes of temperature, vibration and shock.

Specify DAPON (diallyl phthalate) Resin when you need:

- Low dielectric loss
- High dielectric strength
- Superior dimensional stability
- Excellent arc resistance
- High volume and surface resistance after high humidity-high temperature conditioning

Write for FMC's data sheet containing technical information about DAPON, suggested uses for this resin, and the names of DAPON compounders.



FOOD MACHINERY AND CHEMICAL CORPORATION
Dapon Department
161 East 42nd Street, New York 17, New York

NEW MACHINERY-EQUIPMENT

(From page 50)

the printing operation. Bottles move on a flat, vibrationless conveyor through a preheating area, into a completely insulated oven chamber and out through a pre-cooling area, providing three zone control for good cure. Oven employs the "jet" heat distribution principle which speeds drying, and has a fume exhaust system. Units are safety engineered to meet all regulations and minimize operating hazards. Ovens are available in either gas or electric fired models, in 8- and 20-ft. standard lengths with choice of 48-, 60-, or 80-in. belt widths. Units in any other desired length are available on special order. *General Research and Supply Co., 572 S. Division Ave., Grand Rapids, Mich.*

Tip-out drum holders

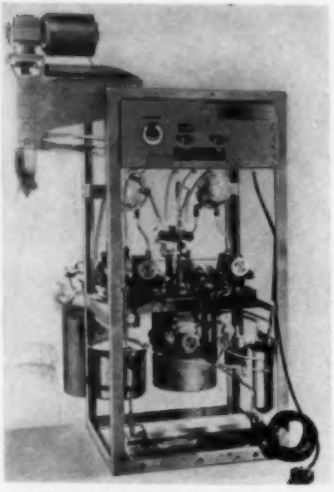
For drum tumbling machines used in dry coloring work, drum holders can be purchased separately for use on existing drive shafts or can be supplied as part of complete, new tumbling equipment. Holder models T-2, T-2A, and T-2B will fit drive shafts having a diameter of 2 5/16 in. and are intended for use on ¾-, 1-, and 2-h.p. drives respectively. For safety reasons the use of the new drum holders is not recommended on heavy duty tumblers having drives of 3-h.p. or over. The holders are designed for floor level loading and have a three-point cover lock (snap lock plus safety pin) and spring assisted lever lift which helps the operator "tip out" the drum and facilitates unloading. Price for Models T-2 and T-2A (for the holders only) is $213.00 and the T-2B holder is $236.00. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Rigid poly slabber

For processing large blocks of foam into sheets of any thickness from ¼ to 8 in. the fully automatic Rigid Poly Slabber has a 50- by 146-in. power driven reciprocating table and can handle foam blocks up to 24 in. thick. Feed rate and blade speed are adjustable for various rigid foam densities. A foam block is placed on the table and the splitting head is vertically adjusted for the required sheet thickness. After splitting, the table returns to the start position at twice the cutting rate speed. Then the splitting head automatically indexes into position for the next cut. Indexing mechanism raises or lowers the head 48 in./min. for rapid production rates. The splitting head uses a band saw type blade. Blades of variable gage and tooth designs are available for different types of rigid foams. *Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio.*

Resin dispenser

Called the 100 Series System, this unit meters, mixes, and dispenses reactive liquid systems including polyurethanes, epoxies, polyesters, etc. It is capable of both continuous flow and intermittent individual charges up to 120 shots/min. at pressures to about 3000 p.s.i. The system comes complete with double-acting, electrically driven, piston metering elements, reservoirs, solvent purge, all controls, and mixing head. The mixer reactor head is jacketed for heating or cooling and has a sharp, cut-off valve on the dispensing nozzle to prevent after-drip. Resins with pot lives down to 8 to 10 sec. can be handled without freeze-up, and component ratios from 1:1 to 2000:1 can be set up. Volumetric accuracy for each component is ±0.5 percent. Prices begin at $5800 F.O.B. manufacturer. *Novo Industrial Corp., Edmund and Shelmire Sts., Philadelphia 36, Pa.*



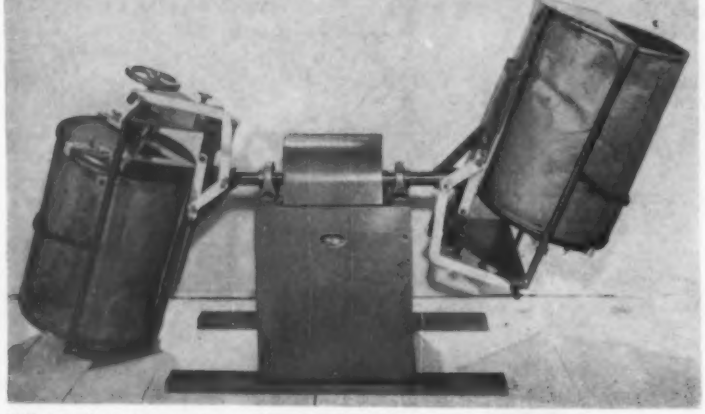
NOVO 100 Series metering-dispensing system illustrating internal construction. Dispensing nozzle is at left.

Internal mixer

Fast cycle, excellent dispersion, easy cleaning and mixing chamber access, were designed into the Model PM50 heavy-duty internal mixer by having the kneading rotors supported from one side **(To page 55)**

Specifications: Krauss-Maffei internal mixer

Volume of mixing chamber, gal.	19.3
Net volume of chamber, gal.	13.2 to 14.5
Max. ram pressure, p.s.i.	171
Max. door clamp force, tons	50
Time to close or open door, sec.	3
Approx. discharge time, sec.	15
Typical cycle for PVC, min./batch	3
Typical production rates for PVC. (Max.)	
Manual charging, lb./hr.	3300
Semi-automatic charging, lb./hr.	4400



IMS Tip-Out drum holders, showing the hand-operated lever linkage, which assists removal of drums from tumbler.

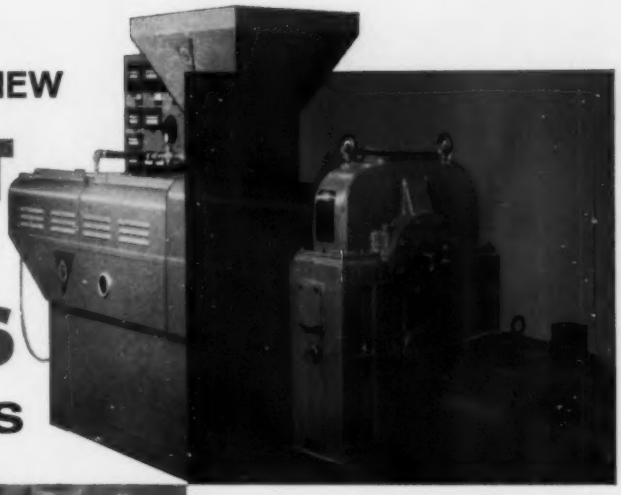
Years Ahead! The VERSATILE, NEW

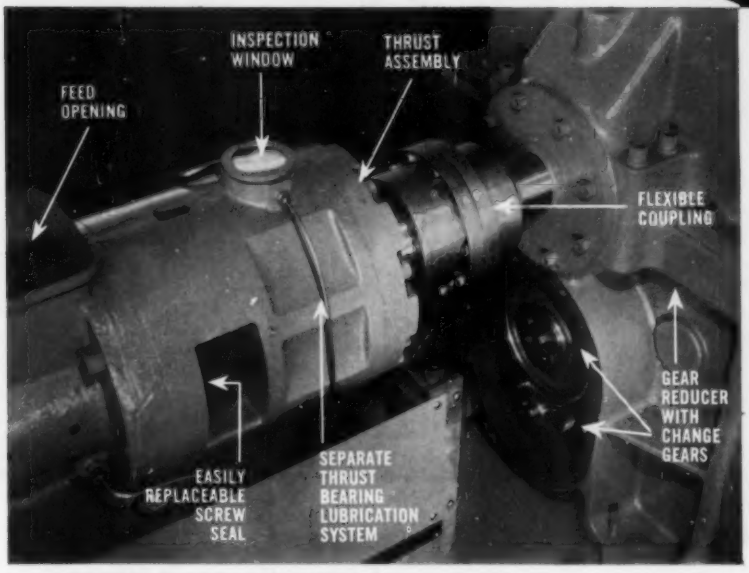
PRODEX HT

HIGH TORQUE

EXTRUDERS

with CHANGE GEARS





BOTH HIGH AND LOW VISCOSITY MATERIALS CAN NOW BE EXTRUDED AT MAXIMUM H.P. EFFICIENCY AND OUTPUT

LOOK AT THESE HORSEPOWER RATINGS	
EXTRUDER SIZE	HORSEPOWER RATINGS
1¾"	7½-10
2½"	20-40
3½"	40-100
4½"	60-150
6"	125-200
8"	200-400

The versatile PRODEX **HT** EXTRUDER gives you the opportunity to quickly select the optimum reduction ratio and screw speed necessary to achieve the highest possible production rate for each extrusion job.

This is now possible because the new PRODEX gear reducer with change gears is capable of transmitting as much torque as the screw can handle. All plastic materials can now be run at maximum output and horsepower efficiency of the motor drive.

Let us show you **all** the new features incorporated in the new PRODEX **HT** EXTRUDER. See it perform with your own materials in our customer service laboratory. Write or phone for appointment.

ONLY PRODEX HAS ALL THESE DESIGN FEATURES

- GEAR REDUCER: Vertical design for space saving and extra ruggedness. Herringbone gears thruout.
- CHANGE GEARS: For selection of the optimum reduction ratio and screw speed at any time.
- SEPARATE THRUST ASSEMBLY permits easy accessibility and maintenance. The spherical roller thrust bearing used in all machines is self aligning.
- SEPARATE THRUST HOUSING LUBRICATION SYSTEM: Oil is continuously circulated by a gear pump through a filter cartridge. Best bearing oil can be used. No compromise between gear and bearing lubricant as in other machines.
- FLEXIBLE COUPLING to absorb thermal expansion misalignment between gear reducer and extruder. Avoids any possible thrust load on gear reducer.
- FULL DIAMETER SCREW SHANK to handle heaviest torque load.
- INSPECTION WINDOW on thrust assembly housing permits visual bearing and oil feed inspection.
- EASILY REPLACEABLE SCREW SEAL to prevent leakage of dusty powders and for use of vacuum hoppers and melt feeds.
- FEED OPENING: Large rectangular opening with cooling jacket. Permits feed to flow freely.
- SELF CENTERING cylinder front support greatly reduces cylinder and screw wear.
- FULL LENGTH HEAVY MACHINE BASE
- FULLY AUTOMATIC heating and cooling controls.
- SIZES: 1¾" to 8" diam. L/D ratios 20:1, 24:1 and 30:1.
- SINGLE AND MULTIPLE STAGE VENTING
- CONTROLLED PRESSURE VALVING
- INLAY HARD-SURFACED SCREWS (not flame hardened) keep their hardness through highest extrusion temperatures.

Write for illustrated bulletin E-6.

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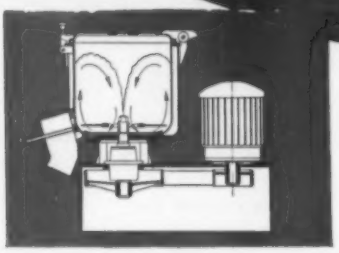
—the revolutionary

PRODEX-HENSCHEL MIXER

for INTENSIVE

- ✓ Resin Dryblending
- ✓ Pigment Dispersion
- ✓ Mechanical Heating

of resins and compounds in EXTREMELY SHORT CYCLES WITH EXCELLENT UNIFORMITY!



In the **PRODEX-HENSCHEL MIXER,** a specially designed propeller-like impeller rotates at peripheral speeds of about 150 ft/second. The centrifugal action of this impeller creates a rapid and continuous flow of the mixer charge through the impeller blades. The high impact velocity of the blades and their shearing action break down agglomerates and cause intimate dispersion of all ingredients. The impeller is designed for large energy transfer to the mixer charge so that rapid mechanical heating is also obtainable. The heating rate is controlled by selection of the proper speed on the multiple speed motor drive. Mixing cycles for complete dispersion are usually so short that heat build-up is negligible where it is not desired. The mixers are jacketed for heating or cooling, and a stock temperature indicator is provided for continuous observation of the batch temperature.

Hundreds of PRODEX-HENSCHEL MIXERS are being successfully used for...

- ✓ **Plasticized Vinyl Dryblending**
- ✓ **Rigid PVC Dryblending**
- ✓ **Pigment Dispersion in Polymers**
- ✓ **Acetate and Butyrate Dryblending**
- ✓ **Filler Mixing with Thermosets**
- ✓ **Fibre Mixing with Polyesters**
- ✓ **Dry Coloring**

PRODEX-HENSCHEL MIXERS ARE AVAILABLE IN FOUR SIZES

TOTAL CAPACITY (cu. ft.)	0.37	2.7	5.3	17.5
USEFUL CAPACITY (cu. ft.)	0.25	1.8	3.5	11.5
MOTOR H.P.	2	15	32	92

Also available in vacuum-tight construction for vacuum extraction with large material surface exposure and continuous agitation.

The **PRODEX-HENSCHEL MIXER** is cleaned in minutes, due to its smooth interior design. All contacting surfaces are made of stainless steel. It is easily loaded and discharged while running.

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(From page 52)

and both rotors rotating in the same direction. Also, the entire front of the machine covering the mixing chamber swings open providing complete access to the mixer. Both the door and the feed hopper ram are operated automatically by a hydraulic system. Dry seals are used on the rotors to limit the loss of plasticated material. Rotors are electrically driven and are available in speeds of 33 and 50 r.p.m. using driving inputs of 180 and 270 hp., respectively. Other specifications are shown in table on page 52. *Krauss-Maffei, Aktiengesellschaft, Munchen-Allach, Germany.*

Injection press

This small 1½ oz. Manumold press can be bench mounted or can be supplied with an appropriate metal stand. A hydraulic system is used to provide injection pressure up to 15,000 p.s.i. Molds are clamped in the injection position using a manually operated, water cooled, vise-type mold clamping device. Three types of plasticating cylinders are available: general purpose, nylon, and PVC. Cylinders are interchangeable, can be changed in 30 sec. (while hot), and are self aligning. All are fitted with turbulence promoting devices. Molds 2½ by 5 by 3 in. are the standard size most suitable for the press. Because of modular construction, press can also be supplied with manually operated injection units. *O. Florin Ltd., 88/90 Holloway Rd., London N.7, England. U. S. Agent: Gilbert Rogers, 1011 S. Maple, Freeport, Ill.*

Multicomponent resin mixers and dispensers

The 600 Series of proportioning pumps is designed to handle all types of multi-component resin systems. The Series 600 Type II accurately proportions, mixes, and dispenses measured shots of two-component resins; Type III delivers measured shots of three-component resins; and Type IV delivers a continuous flow of two-component resins up to 40 lb./min. Included are an integral heating system, cooling for mixing chamber, front mounted controls for shot volume and shot rate, stainless steel splash panel, displacement pump with positive valve mechanism, and adjustable speed agitator. Within corresponding types, variations are available in volume per shot, rate of shot, ratio range,

HARDMAN 600 Series of proportioning pumps is designed to handle all types of multi-component resins.

and volume mixing chambers. *H. V. Hardman Co. Inc., 571 Cortlandt St., Belleville, N. J.*

Extruders

Designated the Pacemaker Series, a line of 3½, 4½ and 6-in. extruders offer Tuck-Under drives with the motor and speed control under the barrel to save floor space. Modular design permits selection of the drive gear ratio, thrust bearings, drive power, screw design, and a heating-cooling scheme to match the extrusion requirements of the material used. Extra-capacity drive and thrust elements can be installed without rework of the basic unit. Optional Temp-Flo closed-circuit cooling circulates a liquid coolant through individual coils in each barrel zone, thence through a water-cooled heat exchanger into a supply reservoir. Instrumented valving for each zone controls coolant flow to maintain even temperatures. Extruders are offered vented or non-vented, induction or resistance heated, and with liquid or air cooling. Additional specifications appear in table below. *National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio.*

. . . Machinery in brief

▸ Adjustable industrial pulse switch for controlling pneumatic valves where permanent-duty solenoids are not used. The exclusive feature of the 1PD1 is the adjustable pulse length. *Micro Switch, a Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.*

▸ A radically new 6-in. fractionating oil diffusion pump designated H6-1500, which provides 70% more speed, 275% higher fore-pressure tolerance, 40% less backstreaming, lower ultimate pressures, and is 34% shorter than its predecessor, promises to improve the performance and decrease the operating costs of high and ultra-high vacuum systems used in metallizing plastics. *NRC Equipment Corp., 160 Charlemont St., Newton 61, Mass.*

▸ Designed specifically for fast accurate blending of powders, pastes, and liquids, such as vinyl dry blends, a line of ribbon blenders featuring automated control is currently available from *Tower Iron Works, 60 Borden St., Providence, R. I.*—**End**

Specifications: NRM Pacemaker series of extruders

Model:	3½	4½	6
L/D ratios available	20 or 24:1	20 or 24:1	20 or 24:1
Effective screw length, in.	69¼	89 1/16	118¾
Nominal screw diam., in.	3½	4½	6
Max. operating press., p.s.i.	10,000	10,000	10,000
Max. output, lb./hr.[a]	300	550	750
Feed opening			
Standard round, in.	3½	4½	6
Optional rectangular, in.	7 by 3½	9 by 4½	12 by 6
Transmission h.p.[b]	75	125	300
Motor h.p.	25 to 75	50 to 125	100 to 300
Rated motor h.p. delivered to screw			
At full speed, %	95	95	95
At ½ full speed, %	32	32	32
No. of heating zones	4	5	5
Heater wattage, kw.	25.8	38.5	62

[a]Using polyethylene with Sp. Gr. of 0.92 and melt index of 2. [b]At 100-r.p.m. screw speed.

WORLD-WIDE PLASTICS DIGEST*

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Plastics make a dent in paper markets. G. B. Hegeman. Chem. Eng. *67*, 88, 90, 92 (May 16, 1960). The equivalent of 365,000 tons/year (5% in sales volume) of packaging, building, and insulation papers have been replaced by plastics. On a cost basis plastics appear likely to continue to improve their competitive position. Although plastics can be more easily formed to a desired packaging form, the raw material cost is higher. Transparent plastics offer large advantages in the packaging field. The prepackaging of fresh produce has sharply curtailed the requirements of small grocery bags. The current use of 85,000 tons of wax paper for bread packaging is threatened by cellophane and polyethylene film. Paper tonnage loss in the dry cleaning garment field is estimated at 40,000 tons. The current trend in electrical insulation is away from paper and toward the use of plastics.

Styrene: Crude oil to polymer. E. V. Anderson, R. Brown, and C. E. Belton. Ind. Eng. Chem. *52*, 550-56 (July 1960). Cosden Petroleum Co. makes 20 million lb. per year of polystyrene in its Big Spring, Texas plant, which is integrated from crude oil to polymer product. It is the only producer to get its ethylbenzene directly from a mixed xylene stream. To do it, Cosden uses a 600-ft. superfractionator, removes ethylbenzene from a stream in which its nearest boiling component is only 3.9° F. away. Cosden plans to increase styrene output to 60 million lb. annually. It will get additional ethylbenzene from the country's first UOP Alkar unit.

Materials

Effects of secondary plasticizers on processing of vinyls. P. D. Sharpe. Plastics Tech. *6*, 46-49 (May 1960). The properties and results that are obtainable with some specific hydrocarbons that are suitable as secondary plasticizers in polyvinyl chloride are described.

Fluorination of polyethylene. J. Pinsky, A. Adakonis, and A. R. Nielsen. Modern Packaging *33*, 130-32 (Feb. 1960). New techniques for fluorination of polyethylene are adopted for use with molded bottles to reduce the permeability, particularly with respect to organic solvents. Data are presented for 4-wk. tests conducted at 73 and 120° F. Fluorinated polyethylene is generally less permeable and usually is equal to or better than lined containers for nonpolar materials. No improvement over unlined bottles is noted for polar solvents.

Low-density fillers for embedding airborne electronic circuits. F. T. Parr. Insulation *6*, 21-27 (June 1960). Fillers of hollow clay spheres, hollow phenolic plastic spheres, urea-formaldehyde plastic spheres, glass microspheres, and silica powder in epoxy resin compositions are compared. Silica powder has been used previously, but hollow phenolic spheres are suggested in order to save weight when the number of heat-generating components is small or when heat sinks are used. Polyurethane foam gives even greater weight savings, but cannot be used where tubes and other heat-generating components are present unless special heat sinks are designed into the package.

New vinyl alkyl ether polymers. A. V. Bogdanova. Vysokomolekuliarnye Soedineniia 2, 576-80 (Apr. 1960). Vinyl-*n*-butyl, vinyl isobutyl, vinyl isopropyl, vinyl cyclohexyl, and vinyl β-decalyl ethers were polymerized in toluene solution at —75 to —78° C. in the presence of catalysts prepared from $TiCl_4$ and $Al(C_2H_5)_3$. The isolated polymers were characterized by their viscosities, solubilities, and thermomechanical curves. A comparative evaluation of the properties of the polymers showed that they differ from the vinyl ethers known up to the present time, apparently because of the regularity of their structure.

Molding and fabricating

Pressure development in extruder screws. B. H. Maddock, SPE J. *16*, 373-78 (Apr. 1960). Pressure readings taken from the head cavity or end of the screw in extruders may yield erroneous results in the calculation of theoretical output rates. Data are presented for several thermoplastic materials obtained through the use of five pressure gages mounted at various positions along the screw length. Deviations in pressures, obtained with changes in barrel temperature, screw speed, and length, on the output rate are discussed and analyzed.

Connections for Ziegler polyethylene pipes. K. Richard, E. Gaube, and G. Diedrich. Kunststoffe *50*, 325-31 (June 1960). Welded joints as well as flanges and fittings are described for joining lengths of polyethylene pipe. The majority of jointing methods, using test procedures that simulated actual conditions in the field, were investigated.

Methods and equipment for mixing, metering, dispersing, and molding epoxies. J. T. Hull. Insulation *6*, 19-24 (July 1960). Existing equipment for handling epoxy resins on a commercial production scale is briefly reviewed.

Applications

Plastics for atom-smashers. J. O. Turner. SPE J. *16*, 365-67 (Apr. 1960). Plastics have become indispensable in the design of parts for high energy nuclear accelerators. Nearly every class of thermoplastic and thermosetting resins has been used. The available combinations of properties have provided mechanical and electrical strength, flexibility, chemical and thermal resistance, and optical and vacuum properties without which many experiments would be impossible.

Leather, plastic, and all-synthetic belts require special maintenance procedures. Paper Trade J. *144*, 18-19 (Jan. 4, 1960). Training, tools, storage, and insulation that give long stretch-free service from plastic belts are given.

Mortar modified with polysulfide-epoxy adhesive speeds roadway repairs. Adhesives Age *3*, 26-27 (June 1960). Polysulfide-epoxy adhesives are mixed with sand to make material for repairing cracks and holes in roads.

Glass-fiber-reinforced plastics in vehicle construction. W. Beyer. Kunststoffe *50*, 284-89 (May 1960). An investigation into the potentialities of RP in vehicle construction is presented. A comparison between the properties of **(To page 58)**

*Reg. U.S. Pat. Off.

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☐ Casting	☐ General Purpose Laminates
☐ Hot Punching Stock	☐ Alkali Resistant Laminates
☐ Cold Punching Stock	☐ Surface Coating

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Pentachlorophenol • Sodium Pentachlorophenate • Sulfuric Acid • Methanol

PLASTICS DIGEST

(From page 56)

these materials with those of steel shows that insufficient is known as yet about the creep or long-term behavior of glass-fiber-reinforced plastics. The material available on this subject is critically examined. The problems of surface finishing and of the behavior of the surface are discussed.

Properties

Relation between the static breakdown and deformation of solid amorphous polymers. M. I. Bessonov and E. V. Kuvshinskii. Vysokomolekuliarnye Soedineniia *2*, 397-403 (Mar. 1960). Creep rate and breaking time of solid polymers are related by empirical equations. A marked difference is observed between the effects of stress and temperature on the rate of deformation and of breaking. To clarify the physical rate of the relation between strain and rupture more sensitive characteristics are needed than merely the macroscopic rates of the processes.

Cure of molded melamine resin and its significance for properties. H. P. Wohnsiedler and R. A. Tiley. SPE J. *16*, 299-303 (Mar. 1960). Methods of measuring the degree of cure of melamine resins by the boiling water and the acid boil tests are discussed. The relationship of flexural and impact strength, electrical properties, and dimensional stability to the degree of cure are presented. Cure depends primarily on the rate of cure and the molding conditions, as well as the part design.

Heat processing versus permeability. E. G. Davis, M. Karel, and B. E. Proctor. Modern Packaging *33*, 208-11, 283-84 (Mar. 1960). The effect of heat processing by steam on carbon dioxide, oxygen, and water-vapor permeability of heat-resistant plastics films is evaluated. Films studied include high-density polyethylene, polypropylene, polycarbonate, polyethylene terephthalate, polychlorotrifluoroethylene, and polyvinyl fluoride. Little effect was noted on gas permeability. Water vapor permeability generally decreased in polyethylene, increased in polyester, and remained essentially the same with the other films.

Dynamic bulk viscosity of polystyrene and polymethyl methacrylate. R. Kono. J. Phys. Soc. Japan *15*, 718-25 (Apr. 1960). Transverse and longitudinal wave measurements were made at frequencies of 0.5, 1, and 2.25 Mc. in the temperature range 20 to 190° C. For the transverse wave measurement, a modified rotating plate method was used. An energy-dissipating process associated with volume deformation was found. The activation energy associated with shear deformation is somewhat different from that associated with volume deformation; the molecular mechanism involved in the two types of deformation may be different.

Testing

Separation of plasticizers from polyvinyl chloride compositions. M. W. Robertson and R. M. Rowley. Brit. Plastics *33*, 26-29 (Jan. 1960). Experimental results are presented for various solvent systems used in quantitative extraction of plasticizers from polyvinyl chloride. PVC sheeting of known composition and plasticizer content was extracted, using single solvents, azeotropic mixtures, and multiple extraction techniques. Plasticizers studied include several phthalic and sebacic acid esters, tritolyl phosphate, alkylsulfonic acid esters of mixed phenols, and polypropylene adipate and sebacate. Best results were obtained with diethyl ether followed by a carbon tetrachloride-methanol mixture.

A versatile high-temperature testing machine for creep, stress relaxation, and static tension tests. W. N. Findley and W. J. Worley. Proc. Soc. Exp. Stress Analysis, *17*, No. 1, 15-22 (1959). A testing machine is described for measuring creep for both small and large strains, stress relaxation, and short-time tension tests at high temperatures. The novel features include means for accurate positioning of the specimen within the furnace, an extensometer that will compensate for dimensional instability of the test material, grips with spherical seats at the ends of the specimen, and means for minimizing the effects of vibration and shock.

Instrument for measuring the permeability of plastics sheeting to moist gases. N. Buchner and G. Schricker. Kunststoffe *50*, 156-62 (Mar. 1960). The methods of measuring gas permeability of sheeting are reviewed and consideration is given to how these methods could be used for measuring the permeability to moist gases. A new instrument that can be used for measuring the gas permeability of plastics film and sheeting as well as coated paper, if the relative humidity of the test gas is known, is described. General conditions, accuracy of the values obtained, and potential applications are reported.

Quantitative evaluation of the deformability of vitrified high polymers. E. E. Glukhov. Vysokomolekuliarnye Soedineniia *1*, 819-24 (June 1959). An apparatus is described for testing plastics under pure shear conditions, with automatic recording of the strain-time curves under load and after unloading. A mathematical treatment of the test results is proposed to calculate the deformation for any time interval at any stress. The dual character of the deformation process, in which stress causes deformations leading simultaneously to a strengthening and to a breakdown of the material, are examined.

Characterization of PVC resins by the conductivity of solvent extract. J. B. DeCoste and B. A. Stiratelli. Rubber Age *87*, 279-85 (May 1960). Interlaboratory tests have shown that electrolytic conductivity measurements on extracts of PVC resins may be used as a simple and rapid test for distinguishing between electrical and non-electrical grades of resin. Results indicate that the most suitable method of extraction employs isopropanol as a wetting agent and water as the extractant. The method fills a need for screening resins before compounding.

Publishers' addresses

Adhesives Age: Palmerton Publishing Co. Inc., 101 W. 31st St., New York 1, N. Y.

British Plastics: Iliffe & Sons Ltd., Dorset House, Stamford St., London SE1, England.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Insulation: Lake Publishing Co., 718 Western Ave., Lake Forest, Ill.

Journal of Chemical Society of Japan: No. 5, 1-chome, Surugadai Kanda, Chiyoda-ku, Tokyo, Japan.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Strasse 7, Munich 27, Germany.

Modern Packaging: Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.

Paper Trade Journal: Lockwood Trade Journal Co. Inc., 15 W. 47th St., New York 36, N. Y.

Plastics Technology: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.

Proceedings of Society for Experimental Stress Analysis: Central Square Station, P. O. Box 168, Cambridge 39, Mass.

Rubber Age: Palmerton Publishing Co., Inc., 101 W. 31st St., New York 1, N. Y.

SPE Journal: Society of Plastics Engineers Inc., 65 Prospect St., Stamford, Conn.

Vysokomolekuliarnye Soedineniia: Academy of Science of U.S.S.R., Moscow, Russia.—**End**

PARAPLEX P-13—For tough, flexible, light amber, transparent polymers. As plasticizer for rigid type resins, improves impact strength and toughness. For potting coils, electronic components and other electrical devices.

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PARAPLEX P-49—A laminating and molding resin with maximum rigidity and flexural strength. Well suited for matched metal die work. Recommended where rigidity at elevated demolding temperatures is needed.

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PARAPLEX P-446A—In cured form, has better resistance to weathering and yellowing than light stabilized polyester resins containing only monomeric styrene. Recommended for glass reinforced constructions where improved weather resistance is desired and where handling difficulties prevent use of PARAPLEX P-444A.

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- Electrical resistance
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- Impact resistance
- Light transmittance
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- Transparency
- Chemical resistance
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U.S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

U.S. Pats., June 14, 1960

Block copolymers. M. L. Miller (to American Cyanamid). 2,940,952.

Epoxide resins. W. J. Belanger (to Devoe & Raynolds). 2,940,953.

Water-soluble phenolics. E. A. Barr and V. Auerbach (to Union Carbide). 2,940,954.

Olefin copolymer. E. C. Shokal and P. A. Devlin (to Shell). 2,940,955.

Acrylyl hydrazine polymers. D. A. Smith (to Eastman Kodak). 2,940,-956.

Polymeric metal-organic compositions. D. F. Herman (to National Lead). 2,940,957.

Polymers of alkyl 1-acetoxyalkenyl phosphonates. H. W. Coover Jr. and R. L. McConnell (to Eastman Kodak). 2,940,962.

High melting polyethylene. R. Mostardini and A. Alberti. 2,940,964.

Acetylenic ether polymers. D. J. Mann, D. D. Perry, and R. M. Dudak (to Thiokol). 2,941,010.

Electroluminescent structures. F. E. Swindells (to Du Pont). 2,941,104.

U.S. Pats., June 21, 1960

Reinforced plastic hollow bodies. O. V. Plym. 2,941,570.

Encapsulation. R. G. Chamberlin and H. S. Evander (to Tung-Sol). 2,941,-688.

Hermetic seal between a metal and a resin. J. F. Burke and N. J. DeLollis. 2,941,830.

Floor covering. J. N. Mason (to Boston Woven Hose). 2,941,913.

Reinforced pipe. F. W. Manning. 2,941,915.

Carbodiimide polymers. T. W. Campbell (to Du Pont). 2,941,966.

Polyurethane foam. F. Moller, E. Muller, P. Hoppe, and G. Braun (to Bayer). 2,941,967.

Interpolymers. J. F. McKenna (to Pittsburgh Plate Glass). 2,941,968.

Ethylene vinyl ester polymers. M. C. Kemnick and F. K. Watson (to Du Pont). 2,941,973.

Halogenated copolymer. L. S. Minckler Jr., D. L. Cottle, and L. T. Eby (to Esso). 2,941,975.

Polyester copolymers. J. Phillipson (to Aerojet-General). 2,941,976.

Molding compositions. A. F. Roche, B. H. Tubbs, N. H. Ruffing, and C. Jones (to Dow). 2,941,977-8.

Polyvinyl pyrrolidone. G. Robinson (to General Aniline). 2,941,980.

Polyesters. W. Gumlich, G. Sprock, and K. Monkemeyer (to Huls). 2,-941,982.

Urethane terminated polycarbodiimides. K. C. Smeltz (to Du Pont). 2,941,983.

Dihydrazide polymers. H. D. DeWitt (to Chemstrand). 2,941,984.

Acrylonitrile copolymers. J. L. Amos and C. T. Miller (to Dow). 2,941,985.

Fluoroelastomers. L. Dewey (to U. S. Rubber). 2,941,987.

Alpha-methylstyrene resin. F. A. Food and P. D. May (to American Oil). 2,941,989.

Cyanoethylated polymers. W. H. Schuller (to American Cyanamid). 2,941,990.

U.S. Pats., June 28, 1960

Extrusion. H. Reifenhauser (to Reifenhauser). 2,942,294.

Thermoplastic fabrics. B. Michalko (to Union Carbide). 2,942,297.

Molding apparatus. A. C. Loedding (to Unexcelled Chemical). 2,942,298.

Foamed polystyrene. W. R. Price and A. S. Houston (to Central Waxed Paper). 2,942,301.

Extruded tubing. R. W. Hilton (to Harvey Machine). 2,942,728.

Shell molding. B. Freedman (to Monsanto). 2,943,068.

Polyethylene-wax compositions. R. Rosenbaum (to Allied Chemical). 2,943,069.

Color stabilizing vinyl plastics. A. C. Hecker and M. W. Pollock (to Argus). 2,943,070.

Diisocyanate-modified polyester. A. K. Forsythe (to Armstrong Cork). 2,943,072.

Vinyl halide polymers. S. S. Feuer (to Rohm & Haas). 2,943,074.

Haloethylene polymers. C. B. Havens and G. A. Clark (to Dow). 2,943,076.

Ethylene sulfur dioxide copolymers. R. B. deJong and I. M. Robinson (to Du Pont). 2,943,077.

Tetrafluorethylene-fluorinated olefin copolymers. M. I. Bro (to Du Pont). 2,943,080.

U.S. Pats., July 5, 1960

Hollow plastic articles. G. V. Mumford, O. B. Sherman, E. L. Adams, and R. C. Gasmire (to Owens-Illinois). 2,943,348-9.

Extrusion. A. N. Gray (to Western Electric). 2,943,351.

Extrusion. J. W. Van Riper. 2,943,-352.

Molding press. W. S. Fraula and W. J. Olson (to American Brake Shoe). 2,943,353.

Molding. H. Z. Gora (to Eagle Picher). 2,943,354.

Cellulose acetate composition. S. G. Hawtin, D. R. Parker, and J. Downing (to British Celanese). 2,943,946.

Polyisocyanate. W. Szukiewicz (to Allied Chemical). 2,943,947.

Fibrous material slab. A. B. Freeman, B. D. Raffel, and R. A. Tripp (to Goodyear). 2,943,968.

Ion exchange. S. Goodman, 2,944,033.

Epoxidized polyester. R. L. Wear (to Minnesota Mining). 2,944,035.

Plastic solder. D. E. Floyd and W. J. Ward (to General Mills). 2,944,036.

Vinyl aromatic resin composition. S. E. Jolly (to Sun Oil). 2,944,039.

Polyvinyl chloride composition. A. C. Hecker and M. W. Pollock (to Argus). 2,944,041.

Polyisobutylene. W. J. G. McCulloch and L. B. Turner (to Esso). 2,944,043.

Stabilized vinyl resin. C. M. Canarios (to Harshaw). 2,944,045.

U.S. Pats., July 12, 1960

Extrusion. G. V. Killgren and D. W. Stephenson (to Blaw-Knox). 2,944,-286.

Extrusion. J. N. Moran (to Phillips). 2,944,287.—End

DRAPEX 7.7 BLOCKS STAINING—2 WAYS

Drapex 7.7, a primary plasticizer with polymeric properties, gives vinyls built-in resistance to stains. It *blocks stain penetration* from the top surface down and from the underside up. This explains its growing use in such vinyl products as floor tile and upholstery.

The low solvating rate of most polymeric plasticizers often causes processing difficulties. Because Drapex 7.7 has a very high rate of solvation, this problem is largely overcome. Similarly in plastisol or organosol coated fabric, through the use of Drapex 7.7 to increase fusion rate, polymeric properties may be obtained without the usual stringent heat conditions which often cause scorching of the fabric backing.

Drapex 7.7 gives vinyls low volatility and excellent resistance to extraction. Recommended for products coming in contact with chemicals—tank linings, vinyl coated gloves, etc.—and where resistance to lacquer marring is important.

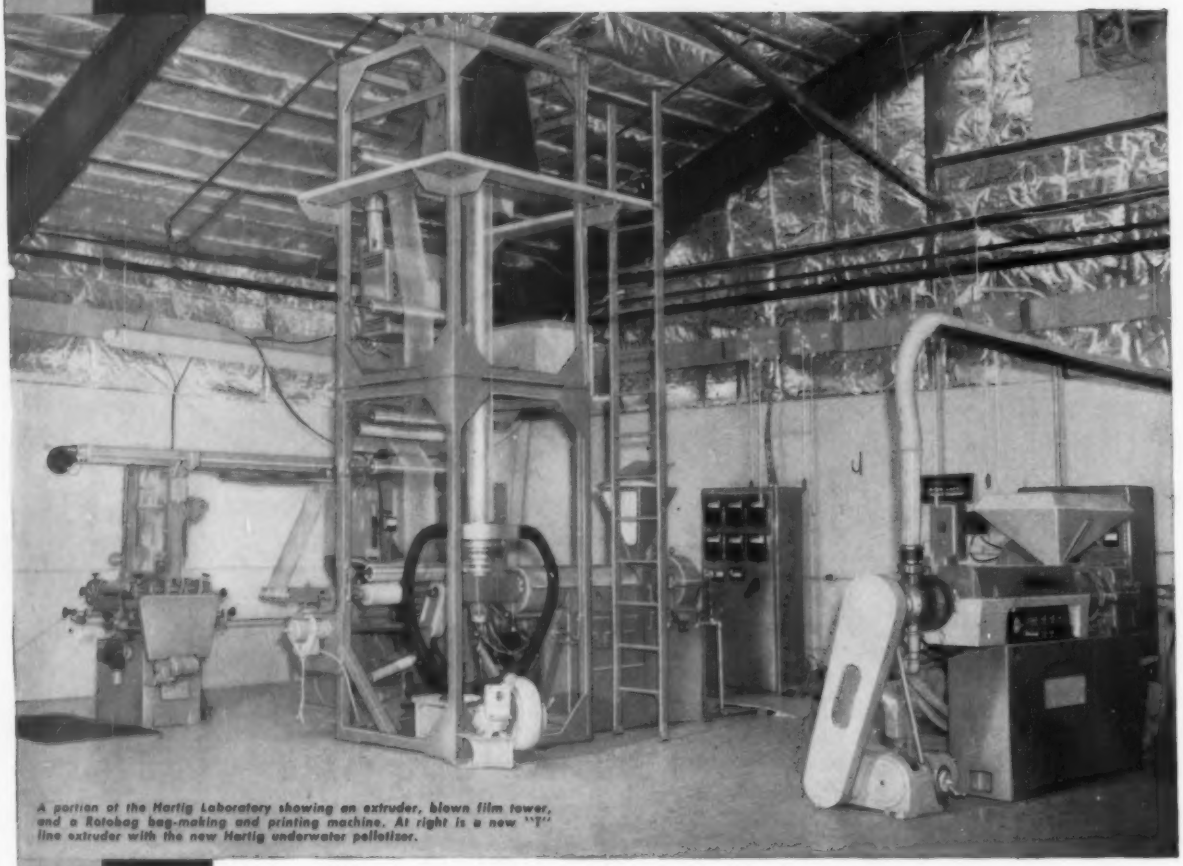
Write for technical bulletin on Drapex 7.7 including results of stain tests.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N.Y. Branch: Frederick Building, Cleveland 15, Ohio

Rep's.: H. M. Royal, Inc., 11911 Woodruff Ave., Downey, California; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal. European Affiliates: SA Argus Chemical NV; 33, Rue d'Anderlecht, Drogenbos, Belgium—Lankro Chemicals, Ltd.; Salters Lane, Eccles, Manchester, England.

the Hartig Laboratory is your laboratory for pre-production testing of extrusion processes and equipment...



A portion of the Hartig Laboratory showing an extruder, blown film tower, and a Rotobag bag-making and printing machine. At right is a new "T" line extruder with the new Hartig underwater pelletizer.

FOR INFORMATION ON FACILITIES & SCHEDULING OF THE HARTIG LABORATORY, CONTACT YOUR NEAREST HARTIG SALES ENGINEER:

Midwest—Chicago Area ..... M. N. Levers
320 So. School St., Mt. Prospect, Ill.
Ph—Clearbrook 5-5300

Midwest—Ohio Area ..... R. Guggenheim
104 Prentiss St., Munroe Falls, Ohio
Ph—Overdale 8-5731

New England ..... R. D. Sackett
15 Westernview Circle, E. Longmeadow, Mass.
Ph—Laurel 5-3853

Metropolitan N. Y. C. ..... Jim Ferrier
Box 531, Westfield, N. J.
Ph—Adams 2-9390

Canada ..... Ron Keeling
1669 Eglinton Ave. W., Toronto 10
Ph—RU 1-5627

Western and Southern Area ..... Contact Home Office
Box 531, Westfield, N. J.
Ph—Adams 2-9390

M-R

HARTIG EXTRUDERS

WALDRON-HARTIG

Division of Midland-Ross Corporation
P. O. Box 531, Westfield, N. J.

Ask for Bulletin FL-1 which describes our laboratory facilities. HE-460

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

Molded polyethylene baby bib features a large catch-all pocket. Molded into bottom front, it traps falling food and keeps crumbs off floor. Bib washes along with dishes, is quick drying.

No-drip polyethylene pouring spout for milk bottles comes in sizes to fit quarts, halves, or gallons. Manufacturer claims it prevents spills and splashes, cleans quickly, lasts almost indefinitely. Available plain or imprinted with dairy name or logo.

New portable impulse sealer is useful for fabricating large items from polyethylene sheet, completely enclosing bulky items in polyethylene, or sealing polyethylene liners of large drums and bags. It consists of separate power pack and hand-operated sealing tongs; produces a seal 8" long, ⅛" wide. It can seal 2 pieces of up to 6 mils each.

Anti-static spray for polyethylene film works quickly and effectively on rolls, sheets, wherever static develops. Helps printers and converters of polyethylene packaging, bags, envelopes, etc. keep up high production rates—by chemically neutralizing static electricity generated by friction or atmospheric conditions. Comes in easy-to-use aerosol container.

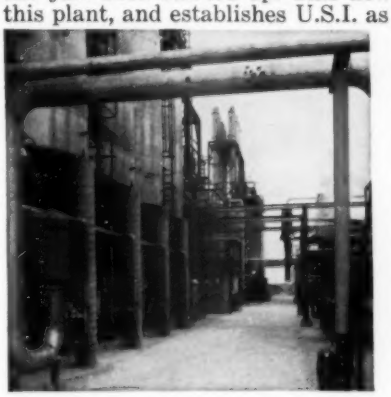
Polyethylene packaging of brown and powdered sugar—recently introduced as "an industry first" by a California company—promises to minimize lumping and caking of these extremely moisture-sensitive products. Because polyethylene acts as a moisture barrier, it keeps the brown sugar moist, the powdered dry.

The 3-mil polyethylene bags used are 3-color flexographically printed. Size is 6½" x 13", suitable for inserting into a kitchen canister. And, once opened, the bag can be reclosed for continued freshness with a simple device offered by the company as a premium.

U.S.I. Doubles Polyethylene Capacity at Houston Plant

New Production Makes U.S.I. World's Second Largest Producer of Polyethylene Resins

A new section of U.S.I.'s polyethylene production plant at Houston, Texas, has just been started up. This new installation doubles the capacity of this plant, and establishes U.S.I. as the second largest producer of polyethylene in the world. This latest expansion brings U.S.I.'s total production capacity of PETROTHENE polyethylene resins to 300 million pounds per year.



View of U.S.I.'s polyethylene plant in Houston, Texas. With plant in Tuscola, Illinois, Company now has total production capacity of 300 million pounds per year.

Rapid Growth Since 1955

U.S.I. has grown rapidly in the polyethylene field. Its first plant with a 25 million pound annual capacity was started up at Tuscola, Illinois, in early 1955. This plant was doubled in size in 1956 and redoubled in 1957 to a capacity of 100 million pounds. In early 1959 the Houston plant was placed on-stream, with a 75 million pound per year capacity (soon increased to 100 million), and this new expansion doubles that plant capacity.

U.S.I.'s PETROTHENE resins have taken a strong lead since their introduction, especially in the film and paper coating markets. According to Vincent McCarthy, U.S.I. Director of Plastics Sales, this market position was built upon a policy of tailoring resin properties for specific applications. Within the past four months, for example, the company has developed and introduced a new produce-bag resin, a new paper coating resin, three new blow-molding resins, a new cast film resin, and two high-flow blending resins.

Production requirements for the new produce-bag resin are expected to make the largest single demand upon the new plant capacity. Introduced only this past April, demand for PETROTHENE 112 is already heavy, because of the unique combination of high-clarity and high-toughness it gives to produce bags and "general-purpose" film.

U.S.I. Announces New Booklet on Bulk Handling

"PETROTHENE® POLYETHYLENE . . . When to Use Bulk Handling," is a 24-page booklet prepared by U.S.I. to help resin users determine:

1. whether or not they should be buying in bulk.
2. which type of bulk packaging would best fit a particular plant's requirements.
3. which type of unloading system to choose.

Or, for processors whose plant is already equipped with a bulk materials-handling system, this booklet offers help with expansion plans and other problems.

Types of bulk conveyances used by U.S.I. to ship PETROTHENE resins are described. Graphs, tables, and calculation sheets show how net savings and payout time for capital invested in bulk handling equipment can be figured.

For copies, write to Technical Literature Dept., U.S. Industrial Chemicals Co., 99 Park Ave., New York 16, N.Y.

New Help for Blow Molders

U.S.I. has just released an 8-page Technical Data brochure entitled, "BLOW MOLDING . . . How to Obtain Highest Quality and Production Rate." It discusses mold cycle time and the more important properties of blow-molded items in detail; then, shows how each is affected by 8 variables.

This information is based on the results of an extensive research program currently being conducted by the U.S.I. Polymer Research Laboratories. Its aim is to find the resin properties and machine conditions which will result in the best product properties—at the most economical production rates. As the project continues, more reports will be issued.

For copies, write to Technical Literature Dept., U.S. Industrial Chemicals Co., 99 Park Ave., New York 16, N.Y.

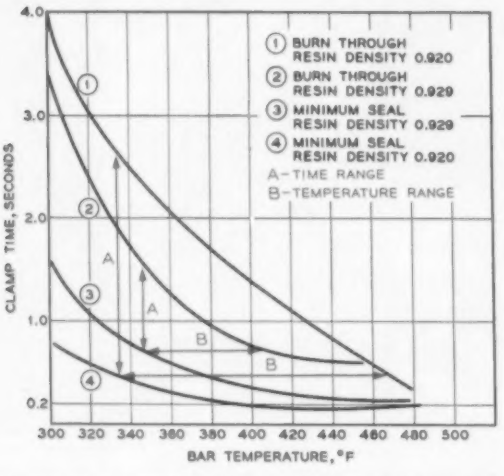
POLYETHYLENE PROCESSING TIPS

Series V, No. 5

MACHINE CHARACTERISTICS AFFECTING HEAT SEALS

Polyethylene film heat seals easily to form air-tight, moisture-proof containers for a wide variety of packaging applications. However, sealing equipment that is poorly designed or improperly used may cause such problems as non-uniform seals, weak seals, or film sticking to sealing jaws.

Many sealers that were adequate when only low-density polyethylene resins were available do not provide the control needed for higher-density, high-clarity films now on the market. The reason, shown graphically below, is that as resin density increases, temperature range between minimum seal and burn-through of film narrows. This range may be narrowed still further by gussets in bags or variations in film gauge.



Increasing density from 0.920 (PETROTHENE® 210) to 0.929 (PETROTHENE 239) results in a narrowing of the heat-seal range between minimum seal and burn-through. (0.5 mil blown tubing)

Temperature Variations

A common cause of poor heat seals is excessive temperature variation along the length of the sealer blade. Best results are obtained when the temperature varies less than 15 degrees F.

With jaw-type sealers, such control may be achieved by replacing or repositioning the heater elements, or if necessary, by replacing the entire sealing jaw. Similar measures work for band-type sealers as well.

It is difficult to measure temperature differences on impulse sealers, but easy to insure desired temperature uniformity. These sealers function by passing an electric current through a wire while it is in contact with the film to be sealed. Temperature differences arise from variations in the diameter of the wire, which offer varying electrical resistances. Hence, regular visual inspections are recommended. When nicks or deformities are found, the wire should be replaced.

Pressure Control

Pressure also must be uniform and accurately controlled across the sealing bar or wire. This is especially true of jaw-type sealers.

Pressure variations may be caused by misalignment of the sealer blade or wire or use of improper backing material. The face of the sealing jaw should be parallel to the backing pad. The preferred backing material is a high-temperature-resistant synthetic material which provides solid backing with just enough resilience to even out small pressure differences.

Most polyethylene seals are made in the 20 psi to 100 psi range. However, many heat sealers in use today were originally designed for materials requiring much higher sealing pressures. It is impossible to control them accurately at lower pressures. To produce consistently good heat seals, such equipment must be modified or replaced.

Serrated Jaws Best

Serrated jaws are preferred to smooth jaws on heat sealers as they eliminate extrusion of the film and resultant weakening of the seal. If smooth jaws cannot be avoided, pressure must be accurately controlled to prevent unnecessarily high pressures and excessive film extrusion.

With some polyethylene resins, film may stick to the jaw, whether serrated or smooth. This can be prevented by installation of a non-sticking membrane between jaw and film or application of a non-sticking jaw.

Match Machine To Use

Impulse sealers are recommended for most in-line sealing and filling operations; jaw or band-type sealers for seals that will not be subjected to immediate stress. Impulse sealing requires less heat, which is more rapidly dissipated, permitting the sealed area to cool and return to full strength sooner. Faster cooling can be achieved with water-cooled backing plates.

Many of these points apply to other kinds of sealers as well as to those mentioned. Further information is given in U.S.I.'s booklet, "Heat Seal Characteristics of Polyethylene Films and Coated Substrates". Write for your copies. And if you have specific problems, contact U.S.I. Technical Service engineers for expert assistance.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
Branches in principal cities

Colorful Polyethylene

. . . offers your customers powerful sales advantages

When you supply your customers with polyethylene film, you provide them a packaging material that offers three important sales advantages. First, the film's toughness provides superior protection for packaged goods. Second, its clarity, high gloss and soft, natural flexibility add a look of quality and a clear unobstructed view of the product. Third, the film can easily be printed with colorful designs, sales messages and product information . . . producing brilliant showcases that draw attention to your customers' products.

Polyethylene film can be printed at high speeds, with sharp registration and good ink adhesion. Packages can be formed on automatic machinery and sealed by heat.

U.S.I. produces a number of PETROTHENE® polyethylene resins ideally suited for producing clear or printed packaging film. These resins offer excellent drawdown properties and a superior combination of toughness and clarity in finished film.

A helpful new U.S.I. booklet, "Printing On Polyethylene", is available upon request. It contains information on film treatment, printing techniques, inks, and field test procedures. For your copy, or for information about PETROTHENE resins, contact your nearest U.S.I. sales office or write to the address below.

U.S.I. is helping to expand your polyethylene film market with ads, similar to this one, addressed to the package-using industries. These ads are designed to pre-sell your potential customers on the sales appeal and other advantages of polyethylene film packaging.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

GUIDE TO PETROTHENE POLYETHYLENE RESINS

RESINS SUGGESTED FOR FILM EXTRUSION

	APPLICATION	GAUGE (MIL)	ESSENTIAL PROPERTIES	SUGGESTED PETROTHENE RESINS
BLOWN FILM	Garment bags	.0.4 to 0.75	.Excellent draw-down, excellent clarity, high gloss, resistance to blocking, good slip.	207, 239, 240-62
	Soft-goods bags	.0.75 to 1.25	.High draw-down, high clarity, good gloss, resistance to blocking, good slip, fair toughness	112, 206, 207
	Produce bags			
	small	.1 to 1.25	.Moderate toughness, clarity, gloss, resistance to blocking, good slip	205, 210 *
	small or large	.1 to 2	.Very high toughness, clarity, gloss, resistance to blocking, good slip	112
	large	.1.5 to 2	.High toughness, fair clarity, gloss, resistance to blocking, good slip	200, 205, 210
	Chemical packaging bags (drum liners)	.1.5 to 3	.Very high toughness, resistance to blocking, good slip	200, 204
	Construction	.4 to 6	.Extreme toughness	200, 301 *
FLAT FILM, CAST & WATER QUENCHED	Soft-goods	.0.75 to 2.0	.High draw-down, clarity, gloss, resistance to blocking, good slip	239, 112
	Overwrap	.0.75 to 2.0	.Excellent clarity, gloss, resistance to blocking, high stiffness	218
	Breadwrap	.1	.Excellent clarity, gloss, stiffness	218
	Produce bags	.1 to 2	.Excellent strength, clarity, gloss, resistance to blocking, good slip	112
	Frozen vegetables	.2 to 2.5	.Extreme toughness, low temperature flexibility	200
	Skin packaging	.2 to 6	.Extreme toughness, good appearance	205, 200
AGRICULTURAL FILM	Mulch	.0.75 to 6	.Moderate toughness, high draw-down	109-216, 201-210

RESINS SUGGESTED FOR OTHER APPLICATIONS

USE	ESSENTIAL PROPERTIES	SUGGESTED PETROTHENE RESINS
PAPER COATING	.. Good draw-down, freedom from odor, good adhesion, grease proofness, heat sealability	
	Best draw-down	203-2
	Highest resistance to permeability	205-15, 239-2 *
	Minimum "neck-in"	201-2, 201-63, 205-15
WIRE AND CABLE COATING	.. Excellent dielectric properties	
	Excellent resistance to environmental stress cracking	
	High frequency insulation, power cables	300-6
	Wire and cable jackets, where unusual stress crack conditions are encountered	300-200 *
	Primary insulation for telephone cables, general insulation where color coding is required	300-Color Code
	Good resistance to environmental stress cracking	
	Neon sign cable (GTO-15)	301-3
	High frequency coaxial cables; primary insulation for telephone cables, multi-conductor control cables, power cables	301-6
	Weather resistant wire and cable; neutral supported secondary and service drop cable	301-200
	WD-1/TT infantry field wire	301-202
	Primary insulation for telephone cables; general insulation where color coding is required	301-Color Code
	General-purpose applications	
	Non-critical, non-specification insulation	302-6
	TV antenna lead-in wire	302-506, 304-516
INJECTION MOLDING	.. Fast flow, maximum stiffness	
	Size:	
	Very large (>20 oz)	208
	Very large (>20 oz), high resistance to low-temperature brittleness and shattering	202 *
	Large (10 to 20 oz)	202, 203, 207, 208
	Small (6 to 10 oz)	201, 203, 206, 207, 239
	Very small (<6 oz)	200, 204, 205, 240
	Best transparency and gloss	101, 207, 208, 209-2, 241
	Best freedom from warp (low level of locked-in stresses)	202 *
BOTTLE BLOWING	.. Best appearance	101, 102-2, 201, 206
	Highest environmental stress cracking resistance	101, 102-2, 301
THERMOFORMING	.. Stiffness, chemical resistance, low water absorption	205, 239
	Maximum resistance to sag	239, 301
	High stiffness and thin walls	239
	Optimum toughness and great flexibility	301
	Good balance of end properties	205
PIPE EXTRUSION	.. NSF approved for potable water	102-216, 109-216
	Nonpotable water supplies	550-218
CALENDERING		102, 102-216, 109-216

FORM: Solid cubes approximately ⅛" on a side.
COLOR: All PETROTHENE types are available in various colors as well as natural.
PACKAGING: 50-lbs. polyethylene coated multi-wall bags, 10,000-lbs. collapsible rubber Sealdbins or 100,000-lbs. Dry Flo railroad cars.
MINIMUM ORDER: 50 lbs.
TERMS: Net 30 days.
AVAILABILITY: Warehouse stocks are maintained in most major processing areas. Your nearest U. S. I. Sales Office will give you detailed information on delivery dates.
TECHNICAL SERVICE: For technical assistance contact your nearest U. S. I. Sales Office.

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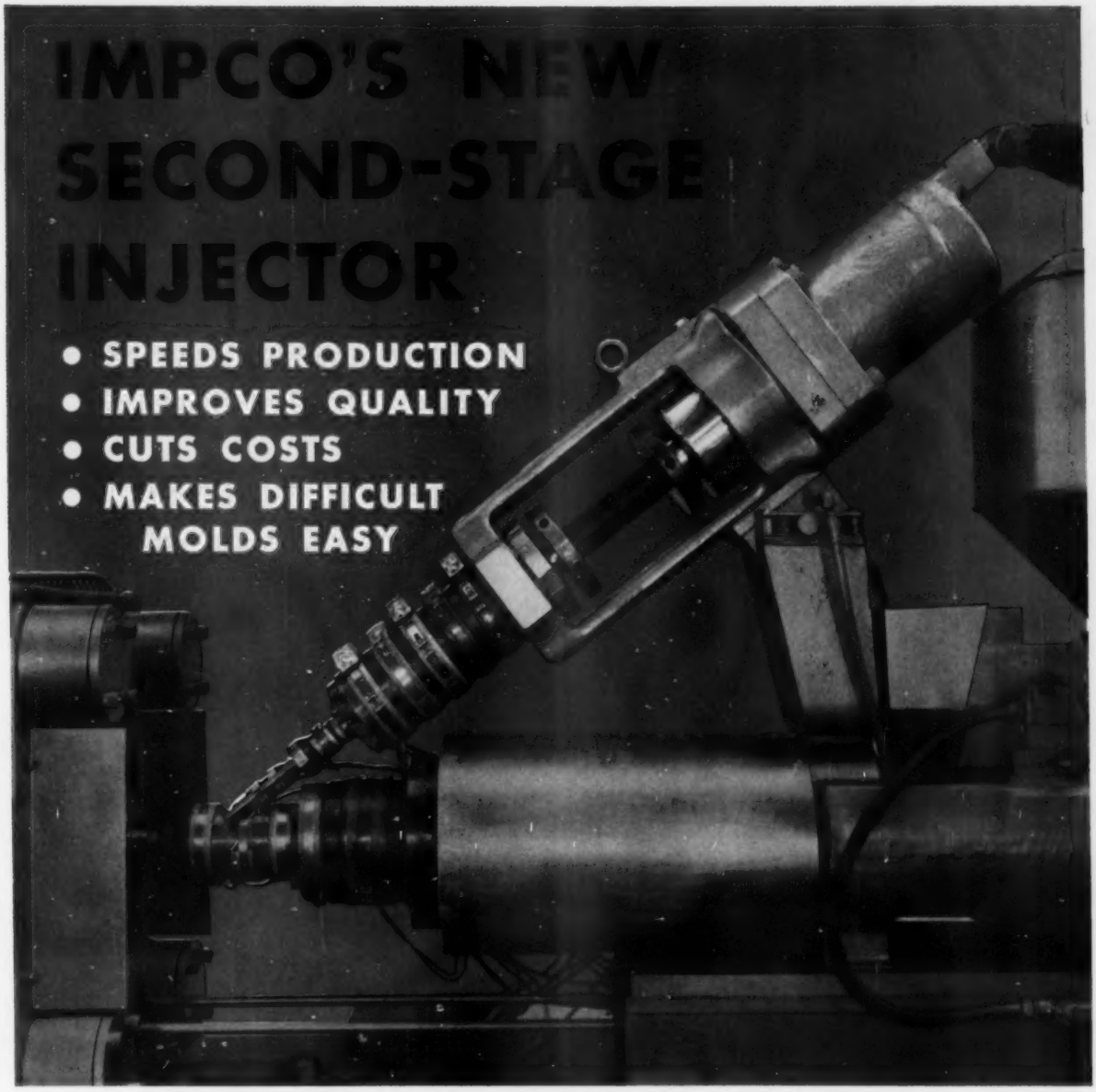


The Second Stage Injector was designed to increase the effective operation of any Impco Injection Molding Machine now in service. It is also now available as standard equipment on new Impco machines. Its use gives you:

- Raw material savings
- Increased capacity
- Reduced molding pressures
- Increased mold area
- Simplified nylon molding
- Fewer rejects

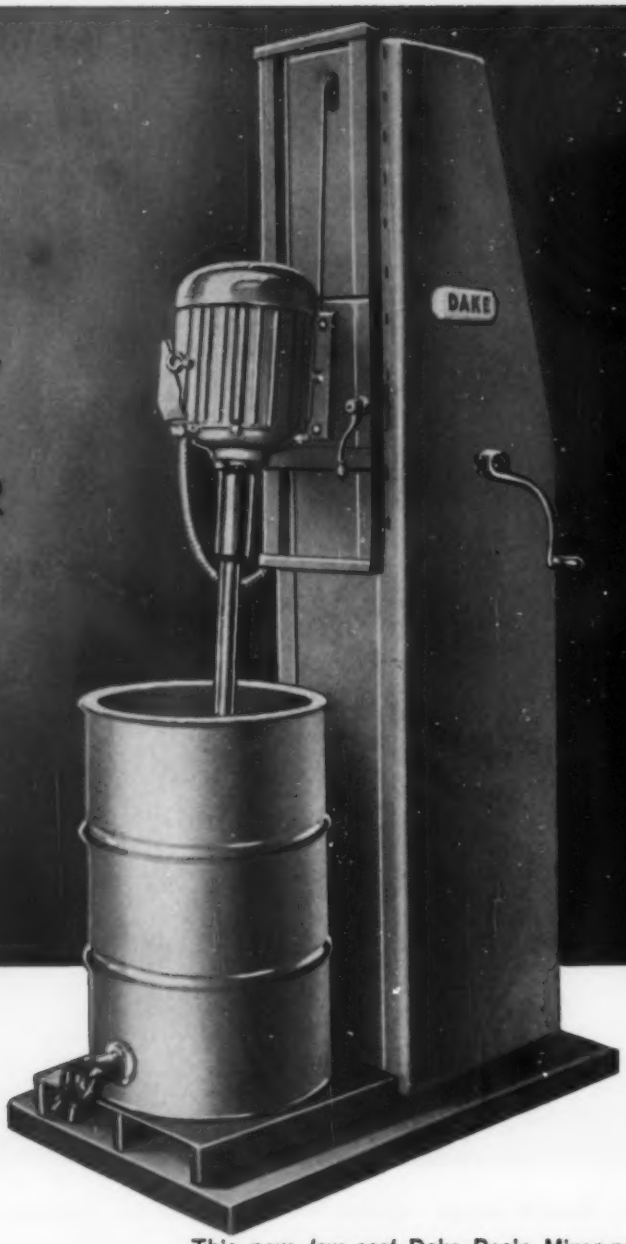
Ask for Bulletin P-127 for more information.

IMPCO®

IMPROVED
MACHINERY INC.
NASHUA, NEW HAMPSHIRE

MANUFACTURERS OF IMPCO PLASTIC MOLDING MACHINES

DAKE RESIN MIXER



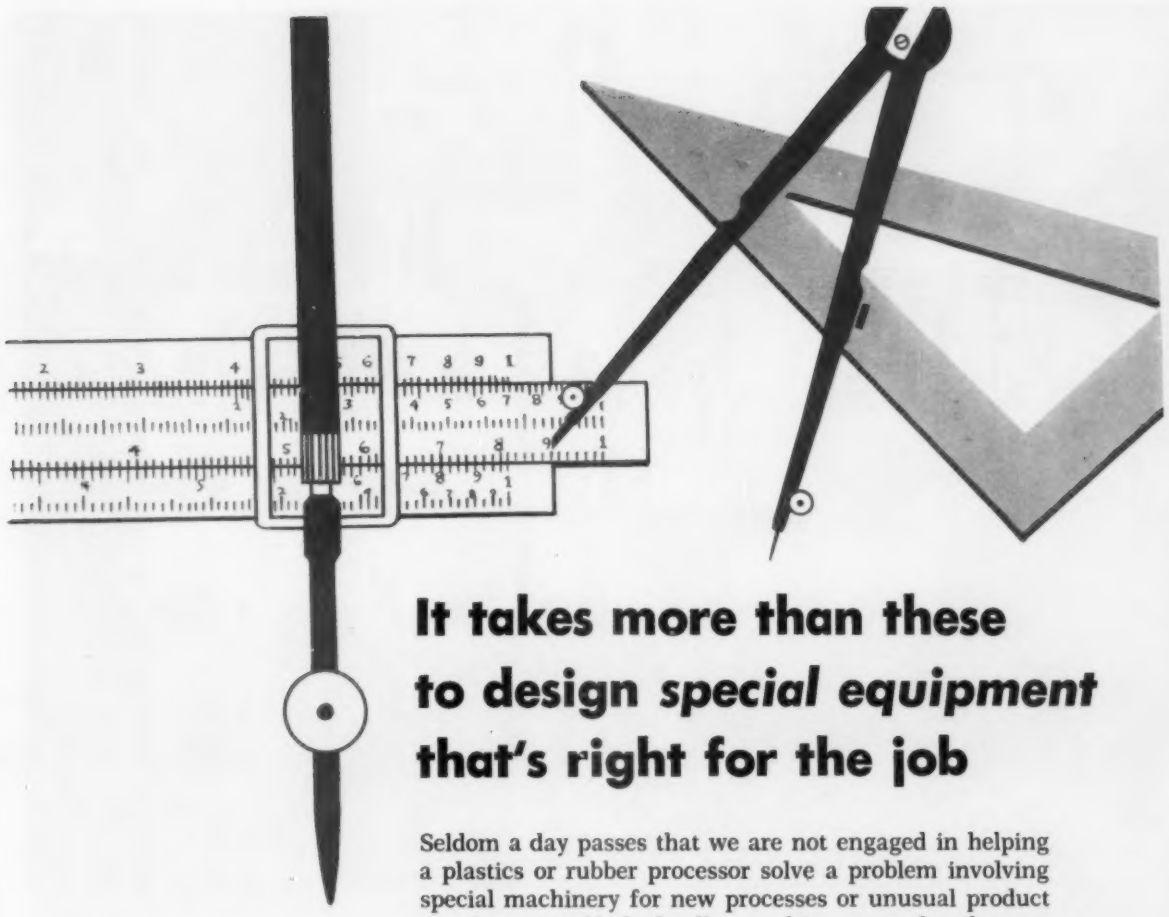
for Faster... More Efficient RESIN BLENDING

This new *low-cost* Dake Resin Mixer provides a perfect, uniform mix at all times. The specially designed disc blade shears in, mixing resin solids rapidly with a bottom-to-top blending action which minimizes heat buildup and lessens *kick-over* hazards. In addition, the mixer is completely self-contained and self-supporting, and the counterbalanced motor can be cranked up or down for loading.

Dake Resin Mixers are available in three horsepower ratings and three disc diameters to meet almost every requirement. Write for Bulletin No. 425 for complete specifications.

DAKE PRESSES

DAKE CORPORATION
648 Robbins Road, Grand Haven, Michigan
Also Manufacturers of a Complete Line of Plastic Molding Presses



It takes more than these to design *special equipment* that's right for the job

Seldom a day passes that we are not engaged in helping a plastics or rubber processor solve a problem involving special machinery for new processes or unusual product requirements. Undoubtedly one big reason for the outstanding success of this phase of our business is that important extra "tool" Adamson United brings to the job . . . the wealth of specialized knowledge gained through more than 65 years of intimate contact with these industries.

Do you need special equipment for a new process? A new design to cut production costs, increase production or improve product quality? Our engineers, who are thoroughly familiar with today's plastics and rubber processing problems, have provided hundreds of manufacturers with equipment that meets these requirements exactly. Adamson United is ready to go to work for you, with a complete service from blueprint to installation. Why not call us in to discuss your particular problems? No obligation, of course.

DESIGNERS AND BUILDERS OF
MILLS • CALENDERS • PRESSES
SPECIAL MACHINERY AND EQUIPMENT
FOR COMPLETE PROCESSES

ADAMSON UNITED
COMPANY
730 CARROLL STREET, AKRON 4, OHIO
Subsidiary of United Engineering and Foundry Company
Plants at Pittsburgh, Vandergrift, Wilmington, Youngstown, Canton

7072

Opal 'Perspex' display stand specially designed by R. Stennett-Willson for J. Wuidart & Co. Ltd., London

Opal 'Perspex' was chosen to display modern glass

TO DISPLAY modern, fine glass so that its background enhances the colour and form without intruding is a very difficult task. R. Stennett-Willson of J. Wuidart & Co. Ltd. chose opal 'Perspex' acrylic sheet to enclose the light source so that the display stands would give an even diffuse light which would show clearly the shape and colour of the glassware without distracting highlights and reflections.

The stand is simple, clean in line and displays the glass to advantage because the opal 'Perspex' contrasts with the glass but remains a background.

'Perspex' acrylic sheet is available in a range of attractive modern colours in opal, transparent, translucent and opaque colours as well as in clear sheet. It is tough, light in weight and easy to clean and maintain.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to: J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd., Plastics Division, Box 10, Montreal P.Q.

ICI

PERSPEX

DANLY®

HYDRAULIC PRESSES

for compression molding,
bonding, laminating,
trimming and piercing
laboratory
general purpose

for Processing Plastics or Rubber

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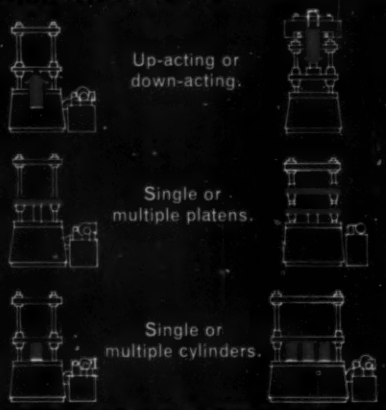

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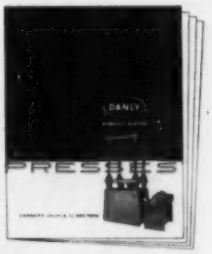

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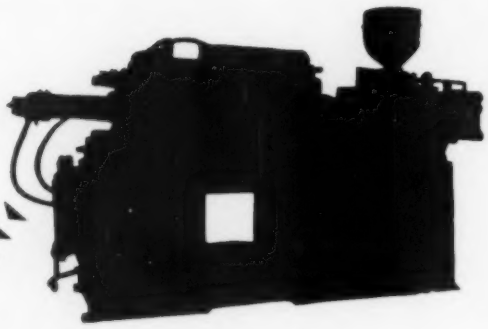

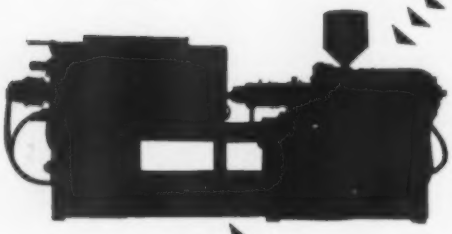

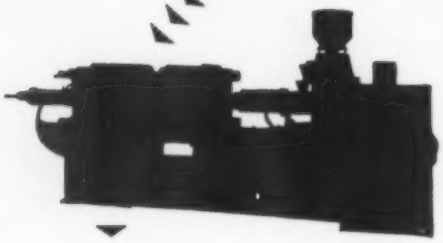

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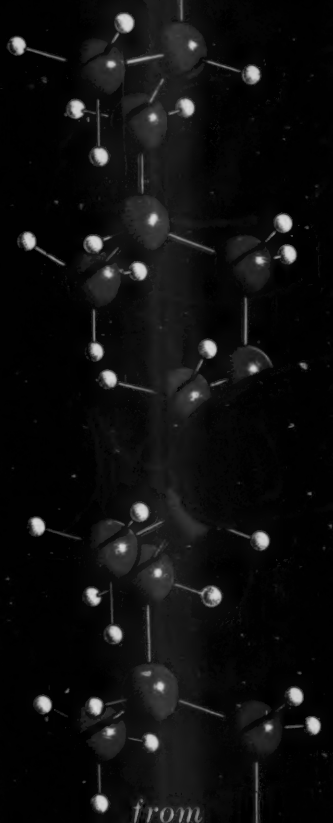

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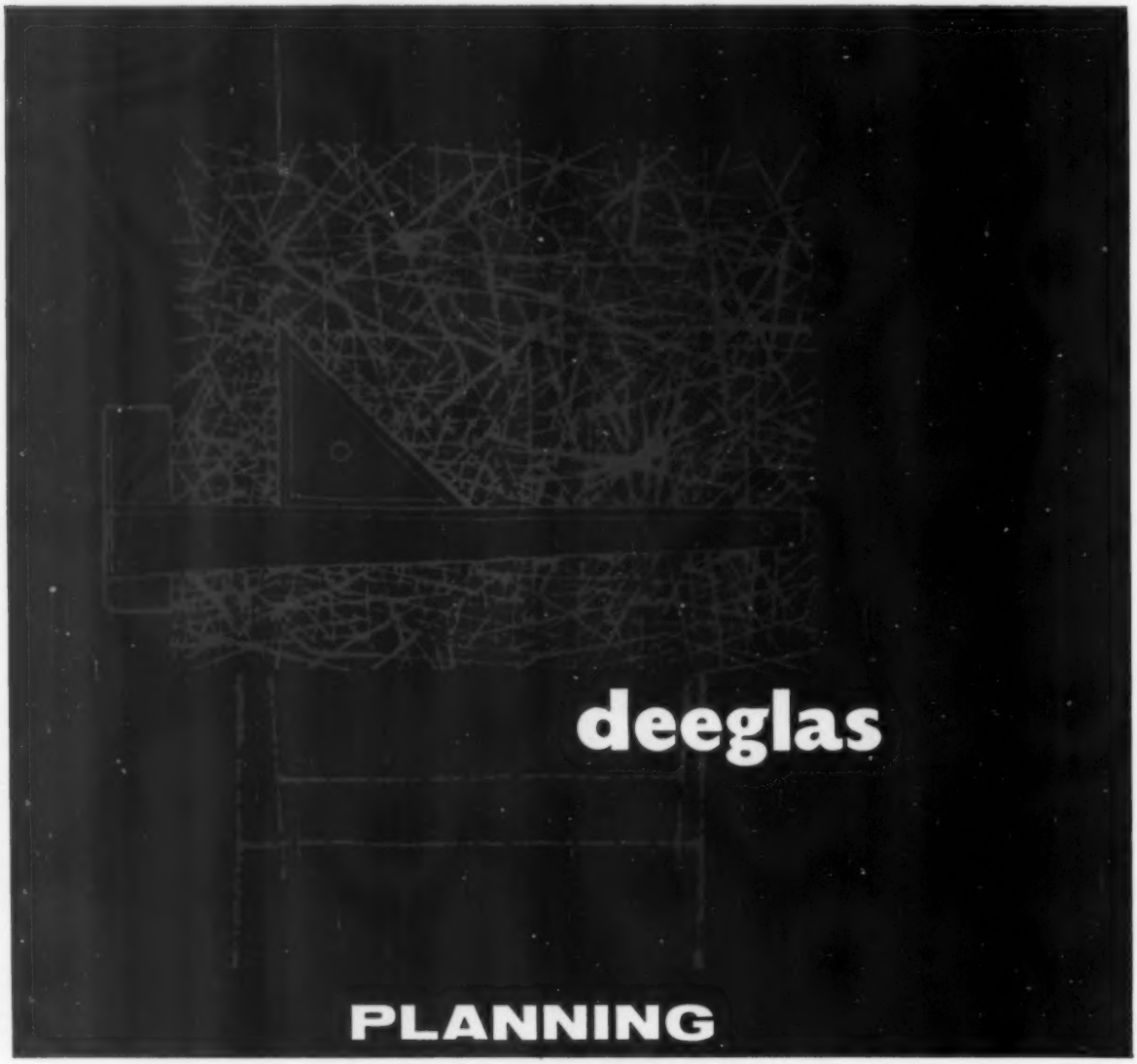

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Sticky Products Won't Stick To Paper with a Syl-off Coating!

Unloading sticky gums, stocks and compounds from shipping containers, storage wrappings and interleaving is no fun when it's a tug of war—it's a costly chore. Manufacturers lose production time and lose money on material left sticking to the wrapper . . . and operators lose their temper.

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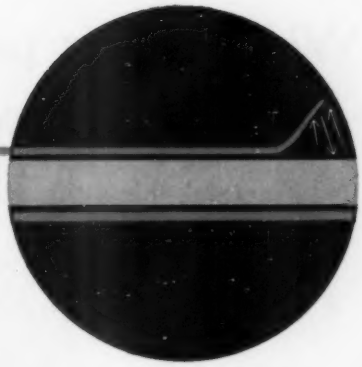
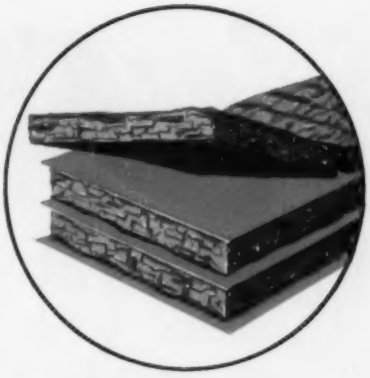
Solving unusual problems with Riegel papers



Stop sticking with



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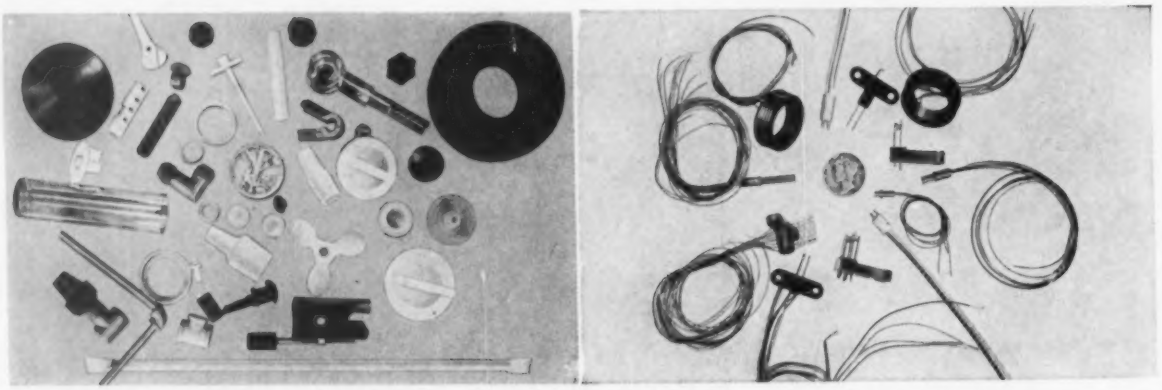

The endless variety of plastic items, sub-miniature to 1½ oz., precision-molded on versatile MINI-JECTORS is suggested in these pictures of parts made on these machines. Even parts involving inserts or loose cores are production molded. Relative size of parts is indicated by half-dollar in left picture and dime in right.

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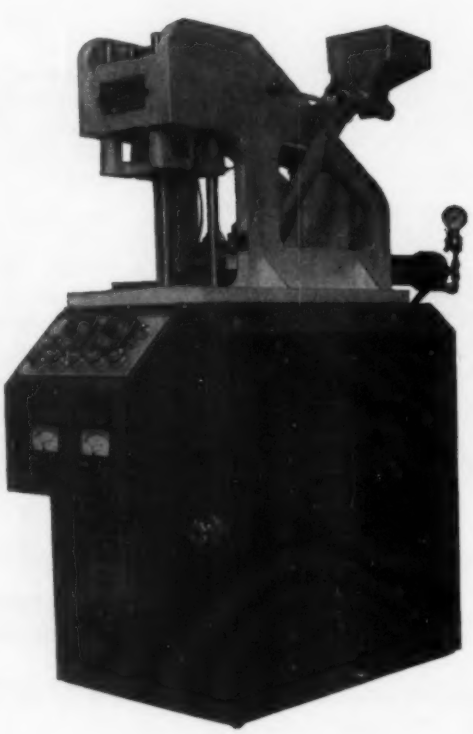

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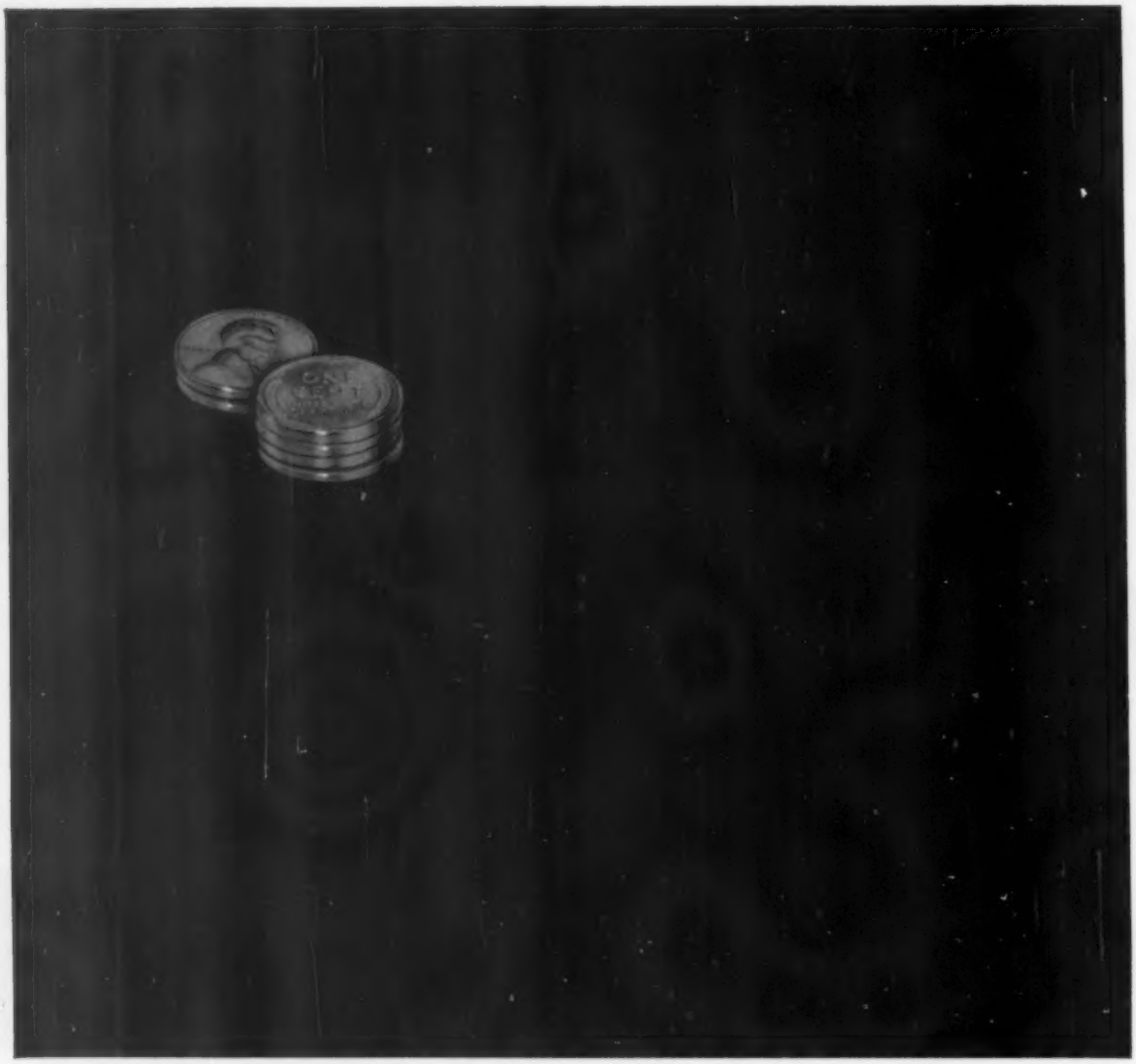

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October 1960, Volume 38, Number 2

MODERN PLASTICS

The widespread current success of vinyl applications in the building industry may blaze a trail to what, for other plastics, is still a "market of the future"

TOMORROW IS TODAY FOR VINYLS IN CONSTRUCTION

The most exhilarating subject pertaining to plastics in recent years has been its gigantic potential for use in the construction industry. Hundreds of thousands of words have been printed pertaining to its potentialities—if only building codes could be rewritten, contractors could be educated, unions could be convinced, and other such traps could be eliminated. But one doesn't build a product from words nor can he do anything about codes, etc., until he has a product to offer.

The vinyl chloride branch of the plastics industry has a vital interest in this development. Here is a branch of the industry that has done more than sky-gazing and wishful thinking. Millions of dollars have been spent in develop-

REPRESENTATIVE of increased use of vinyl in construction is this vinyl waterstop used in bridge abutment on 21-mile Worcester, Mass., Expressway. Design and use of such waterstops are detailed in the following article. Photo, American Enka Corp.

Photo, Bayvo Products Inc.

STORM DOOR consists of five sections of rigid vinyl extrusions, joined by heat welding. Thermal insulation and corrosion resistance properties of vinyl, deliverable at comparable prices, make such items competitive with aluminum.

ment for this field. If vinyl chloride is to reach its goal of 2 billion lb. of consumption before any other plastic, it will have to depend on the construction industry for the largest part of that increase.

This and a following article are devoted to what is being done to fulfill that ambition.

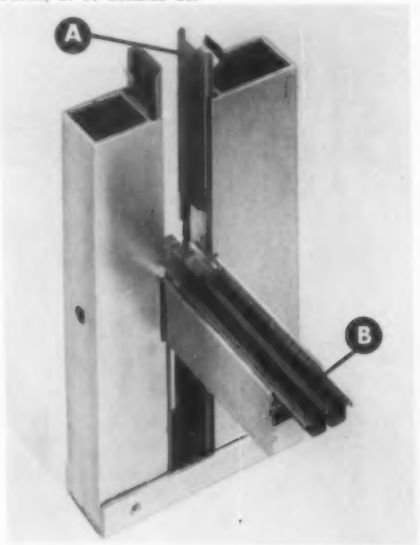
There are applications that have been in use for several years, those that are barely under way, and some that seem almost certain to reach the market in a year or two. This is not imaginary—this is "real stuff." Many of the items are now barely out of the womb—some of them will die in infancy but there are others that will grow into millions of pounds volume. For example, consider the volume consumption that would be possible if every window in every house built in the next 10 years uses a vinyl extrusion for window slides!

Another significant factor in this exciting field is that scores of companies never before interested in plastics are entering the field either as producers or as fabricators of the vinyl products needed for construction jobs.

The entire plastics industry will benefit from this great enthusiasm in construction products. The field offers processors the chance to enter new fields and the manufacturers of extruders, molding machines, and coaters will find new customers among the many large scale building supply producers who are quietly planning to enter the business but are currently frightened lest their competitors find out what is going on—coated and laminated building boards of all varieties are an example of feverish activity among various firms of this sort.

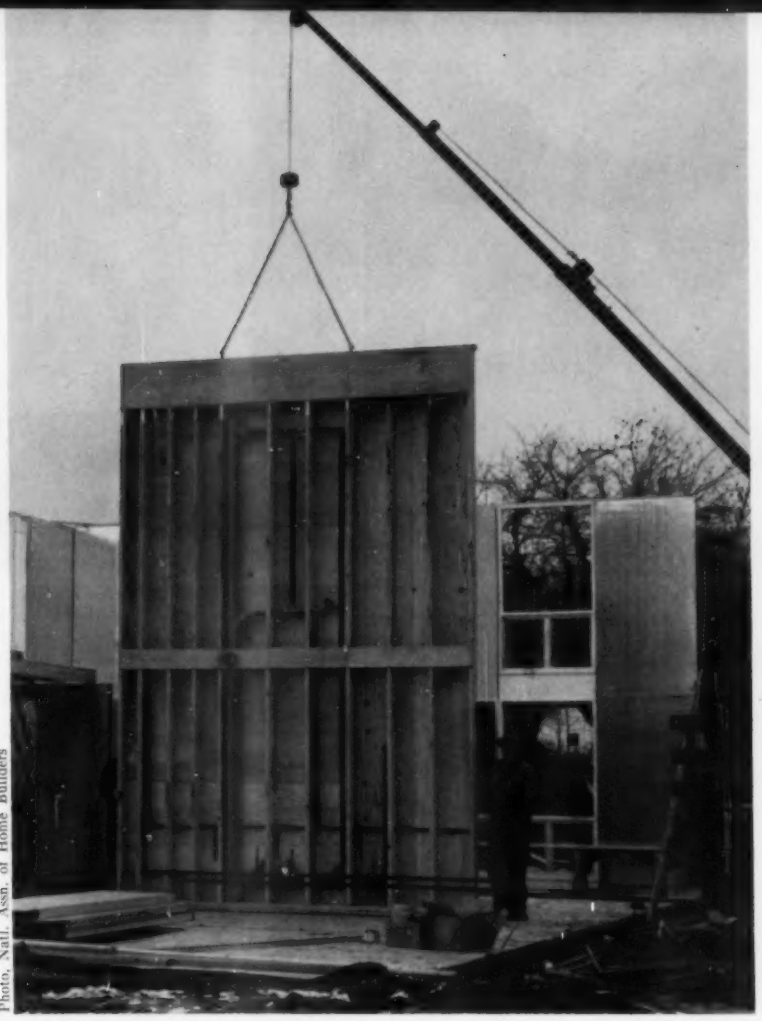
If present plans are realized, vinyl chloride may well take an important position with

Photos, B. F. Goodrich Co.



SPLIT MULLION is used in curtain wall to hold sliding glass panels, incorporates two applications of rigid vinyl extrusions: A) vertical weatherstrip on inner surfaces are backed with clip springs to provide tight seal when panes are closed; B) horizontal channel track enables glass panes to be easily slid open for convenient cleaning from inside building.

VINYL IS FREQUENTLY USED in combination with other materials. In this window, vinyl sash is combined with aluminum trim, provides superior moisture resistance.



NEW high-temperature vinyl pipe portends significant breakthrough into home construction market. Light weight of pipe (only one-quarter that of copper) and ease of installation make more practical pre-fabrication of housing wall sections, such as this one being installed in NAHB research home.

Photo, Natl. Assn. of Home Builders

brick, mortar, wood, and metal as a major source of material for the building industry.

A word of warning, however, is necessary before any company enters this field. It is full of traps, including long delays in acceptance, mis-applications, competitive cut-price operators, consumer resistance, and other problems. No one should enter it without plenty of capital.

Applications for windows

Use of vinyl chloride for window sash, slides, frames, and other appurtenances has many advantages over competitive materials. As in many other construction uses, it enters the field as an extruded shape to compete with wood or aluminum on the basis that it does not gall, stick, nor swell. The building owner likes it because it requires less maintenance—the building contractor finds that as channeling around windows it is easy to handle, light weight, cuts easily and can be readily shaped to fit difficult contours.

Thus, perhaps the most significant trend to increased use of rigid vinyl chloride in construction is to be found in the sash industry. Such companies as Bayvo Products Co., West Collingswood Heights, N. J., and Plyco Corp., Elkhart Lake, Wis., have utilized extruded rigid PVC in many parts of window and door units. PVC is used as framing in storm windows and doors and in combination storm-screen windows and doors; as sliding sash for prime windows; and as the track on which sliding sash rides. The market for all types of window and door units for residential use is estimated at almost 20 million units yearly, with aluminum products now taking about 40% of this market.

How will rigid vinyl become any sort of serious competitor to aluminum and wood? One of the best ways will be in offering far better thermal insulation properties. Rigid vinyl has a K factor, a measure of heat transfer efficiency, of only 0.1 to 3.5, compared with 117.0 for aluminum. This means the virtual elimination of heat transfer through the sash, with freedom

Photo, B. F. Goodrich Co.

VINYL ROOF FASCIA on school building has resisted outdoor weathering for 7 years. Rigid vinyl was selected over porcelain-coated sheet metal, cost about 1/3 less to install. In addition to providing durability, material eliminates rust stains on walls of the school building.

Photo, Navaco Inc.

WINDOW AWNING is made of rigid vinyl slats bound by aluminum crossbars on underside. Spaces between bars diffuse sunlight, yet allow passage of air. Such awnings have stood up to violent hailstorms without chippings or denting, thus outperforming their aluminum counterparts.

from moisture condensation or frost formation on interior glass and sill surfaces.

Moreover, the chemical inertness of vinyl frees the sash from such shortcomings of aluminum as rusting, corrosion, pitting and staining. Rigid vinyl sash also offers integral color for elimination of protective maintenance, nonstick sliding action when used with vinyl sliding track, warmth to the touch, abrasion resistance and removal. Retail prices are said to be comparable to equivalent aluminum products.

The vinyl extrusions are supplied by B. F. Goodrich Industrial Products Co., Plastics Products Div., Marietta, Ohio, and are heat-welded into finished sash products by Bayvo.

Vinyl sliding sash

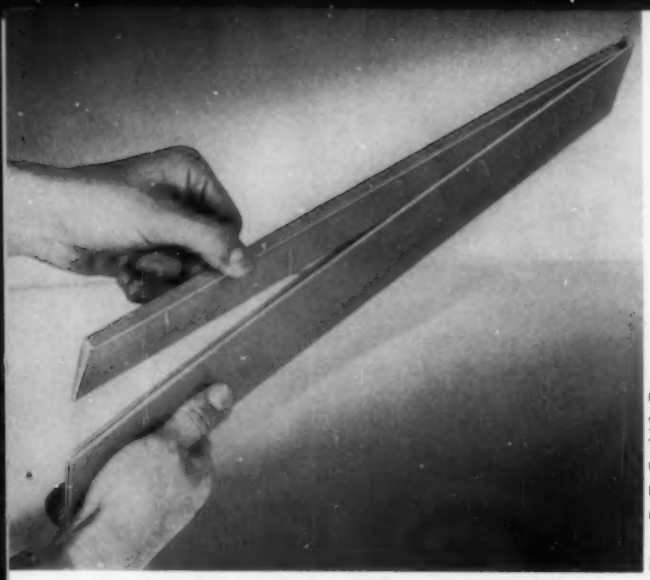
Plyco Corp. offers its Plastiglide sliding window units in two basic models. One unit is equipped with one fixed sash and one movable sash of rigid vinyl. The other is a fixed-center unit with two sliding sections on either side. The sliding track for the prime sash is also extruded from rigid PVC to allow smooth, vinyl-to-vinyl sliding action.

Mobile homes can also enjoy the benefits of rigid vinyl window sash. Woodlin Metal Products Co., Texarkana, Tex., manufactures a one-piece jalousie window, which is designed for trailers, that has a rigid vinyl frame for the glass louvres.

A striking example of how rigid vinyl components can make a new type of construction practical is to be found near Chicago's Midway Airport. There, the Chicago Airways Hotel is built with a front curtain wall that is a departure from the idea of a fixed sheet of metal-framed glass. In this case the glass panels fit into rigid vinyl glide tracks and can be slid open for easier window cleaning from the inside. These panels can be closed by sliding them into vertical split mullions.

One of the biggest problems during construction was to find a weatherstripping material that would allow the sliding sash to close into these mullions and, at the same time, provide the necessary seal against wind and water. When conventional caulking proved to be inefficient for these requirements, rigid vinyl weatherstrip was installed on the two interior surfaces of each split mullion (see photo, p 84). A perfect weather seal was obtained by placing a clip spring behind each weatherstrip to keep it tight against the sliding sash. Gridwall Co., N. Hollywood, Calif., manufactured the curtain wall, and all rigid vinyl profiles were extruded by Ryko Products Inc., Los Angeles, Calif.

Many custom extruders, who gained their early technical know-how from the production of flexible vinyl weatherstripping, now find a large part of their business in rigid vinyl extrusions for sash, sliding track, and window channeling. Among these extruders, in addition to those previously named, are: Extron Corp., Knoxville, Tenn.; Kreidel Plastics Inc., Barberton, Ohio; and Crane Plastics Inc., Columbus, Ohio. The Crane company pioneered in rigid



Photo, B. F. Goodrich Co.

TWO-PART VINYL STRIP is used to form contraction joints in concrete pavements. Placed in wet concrete, strip is removed in two steps: first, T-shaped spreader piece is removed, collapsing V-shaped holder; holder is then easily withdrawn from hardening pavement.

vinyl sash extrusions, and is now supplying rigid vinyl channeling to window manufacturers, primarily those that make sliding units. Approximate prices for 25,000-ft. shipments are 2.9¢ per foot for white and 4¢ per foot for gray channeling.

Pipe and conduit

Vinyl pipe and conduit is considered a building application since it is generally installed while the building is under construction. Unplasticized vinyl chloride pipe and conduit has been gradually moving into this field for several years. Light weight, ease of joining various sections, and chemical resistance are some of its advantages. A new development is Goodrich's higher heat-resistant vinyl dichloride, which its developers believe will be satisfactory for carrying hot water. This, of course, would mark an important breakthrough in the construction field.

Vinyl dichloride is capable of withstanding temperatures 60° F. higher than other vinyls—up to 210° F. in continuous service, compared with the previous vinyl limits of 140° F.

The obvious significance of the new material to the plastics industry is that it opens the rich residential plumbing market to vinyl pipe and tubing. However, the material is also expected to see extensive use as process tubing, ductwork, tanks, and valves for industrial plants, probably a little before residential applications are developed.

Pipe extruded from the material is said to be one-sixteenth the weight of copper. Price is expected to be no more than, and perhaps slightly less than, copper tubing. It is now in pilot-plant production and only limited quantities will be available until next year.

Meanwhile, the developers are pressing ahead with their studies of the known and potential applications. For example, they find that its light weight and ease of handling makes practical the pre-fabrication of wall panels with plumbing. Proof of this can be found in the 1959 research house of the National Assn. of Home Builders constructed at East Lansing, Mich. Hot and cold water piping for this house

Photo, B. F. Goodrich Co.

SEMI-RIGID VINYL CAP on surface of aluminum stair railing provides safer grip, adds color, is pleasant to touch. Extruded vinyl strips are heated until flexible, then fitted over aluminum bar stock as in cross section shown in color above.

was installed in two-story wall panels at an off-site shop, then trucked to the building site and raised into position by a small crane (see photo, p. 85). The high-temperature pipe was extruded by Colonial Plastics Mfg. Co., Cleveland, Ohio.

Pipe and conduit: current uses

Initial commercialization of rigid vinyl about 10 years ago was undertaken in the pipe industry. The story of how Type I (normal impact) and Type II (high impact) vinyl pipe gained wide acceptance as a corrosion-resistant pressure pipe is well known. Briefly, rigid vinyl pipe has met with success in:

...the processing industries, where its abrasion and chemical resistance have combined to make the pipe ideal for handling corrosive liquids and slurries;

...the dairy industry, where its inherent thermal insulation has made the use of pipe insulation unnecessary;

...the gas distribution industry, where its light weight has made it easy to handle and install during gas line service renewal;

...the field of potable water supply, where approval of vinyl pipe by the National Sanitation Foundation for handling of potable water has solidified its place in this natural market.

It is estimated by Colonial Plastics that about 90% of PVC pipe goes into industrial applications, with the remainder used in residential homes, hotels, and apartments, and swimming pools. A great number of rigid vinyl pipe installations have been outdoors, particularly in areas where salt water exposure presents serious weathering problems. Many large resort hotels in Florida, for example, use the pipe for water supply and for exposed piping for air conditioning units.

Rigid vinyl now has the approval of Underwriters' Laboratories for underground conduit, either buried in soil or embedded in concrete. A new line of vinyl electrical conduit has been introduced recently by B. F. Goodrich Industrial Products Co., who recommend it particularly for applications where corrosion resistance is necessary. The conduit, weighing only one-eighth to one-quarter as much as metal conduit, is said to permit savings up to 60% in installations costs. The conduit comes in 20-ft. lengths, thus requiring fewer joints than conventional conduit.

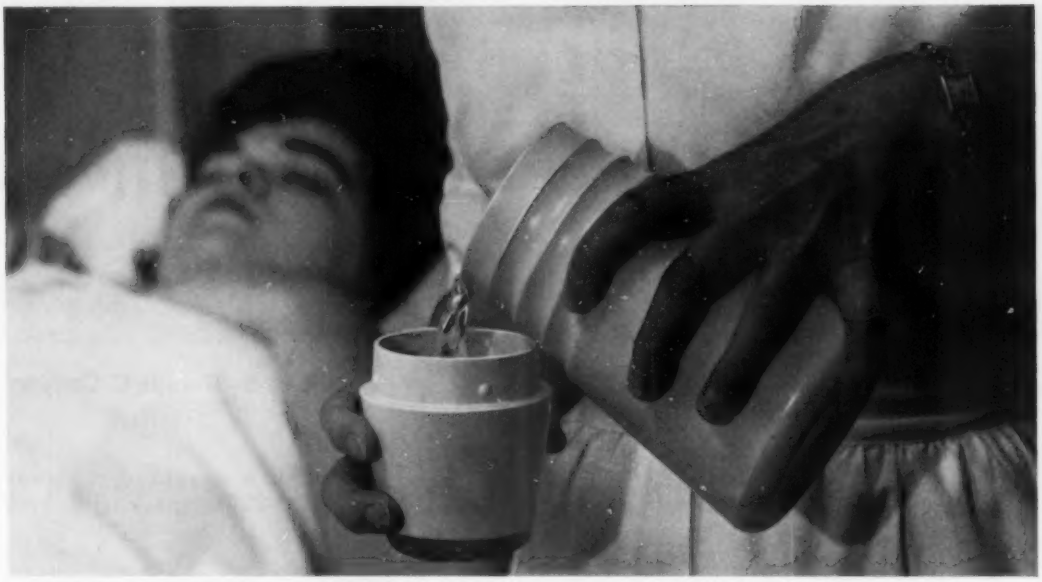
Miscellaneous extruded shapes

A vinyl chloride producer once decorated a Christmas tree with 200 extruded shapes, mostly construction items, to show its versatility. These shapes, easier to form from vinyl than from conventional building materials, compete with practically every known material in the building industry from paper to metal and even gypsum—if not used alone, the vinyl can be married to them (**To page 187**)

WATERSTOPS of heavy-gage extruded vinyl are anchored into adjoining sections of poured concrete to seal joints. Flexibility of extrusions permits necessary expansion and contraction of concrete while completely blocking water seepage. Vinyl is now leading material for such use.

VINYL WATERSTOPS come in a variety of sizes and types, offer a number of advantages over other materials: light weight, chemical resistance, relative ease of heat-joining of seams, and complete flexibility, which permits fold-up to provide full 90° water seal as shown in photo below.

Photos, Union Carbide Plastics Co.



CARAFE IS PROBABLY FIRST COMMERCIAL product blow molded of polypropylene. It offers two distinct advantages to hospitals: it is rated as autoclavable at temperatures up to 275° F.; design protects rim of decanter and lip of cup from air-borne bacterial infection.

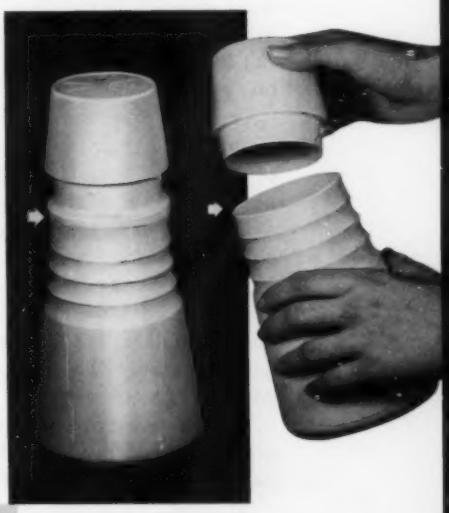
Autoclavable carafe

One of first U. S. applications of blow molded polypropylene provides hospitals with combination cup-decanters that weigh up to 66% less than stainless steel and glass containers, protect better against infections

Through proper material selection, ingenious product design, and the blow molding technique, American Hospital Supply Corp., Evanston, Ill., has succeeded in developing a hospital carafe that offers protection against Staph infections and safeguards patients against air-borne bacteria.

The material: Pro-fax polypropylene, supplied by Hercules Powder Co.

The design: a one-piece blown container, the bottom part of which becomes the carafe proper and the top part of which turns into a removable lid that also serves as the drinking cup. The lid has a recessed top so that when inverted into the cup position it will stand firmly on the table. As shown in the accompanying sketch, when in the closed position, the drinking lips of the cup are inside the carafe and not exposed to air. At the same time, the rim of the carafe is covered in turn by the cup so that no air-borne particles can enter it. A scalloped design was developed for the carafe body to provide a firm grip to patients who may be weak and nervous. The carafe mouth is large enough so (To page 193)



DESIGN IS NEEDLE-BLOWN in one piece. Drinking cup lid is cut off at point indicated and excess edge machined off to permit insertion into the decanter section of the carafe.

CUT-AWAY VIEW SHOWS how two parts of carafe fit snugly together, with inner surface of decanter pressing against drinking rim of cup lid and lid resting firmly on the top edge of the carafe to insure a tight seal.

To MOLD or to MACHINE,

The answer is generally found in the quantity of parts involved and their contours. Five representative products have been costed out to show where break-even point lies

By George C. Carlyon*

Whether a given thermoplastic part can more economically be produced by machining or molding depends on many criteria, of which quantity is only one.

There is a break-even point in volume above which molding is clearly cheaper than machining. But that threshold varies from part to part. Depending on design considerations of the part, machining may be cheaper for runs of 200,000 (in some cases, up to 1 million) or molding for runs of 100.

The following factors lower the machine vs. mold break-even point in favor of molding: *Small part size, intricate contours, abrupt changes of contour, contours in several planes, and integral components or inserts.*

The following factors raise the break-even point in favor of machining: *Large part size, thick wall sections, close tolerances, hard to mold designs (e.g., blind hole, reverse taper, internal thread, undercuts, thread across parting line), frequent design changes, early delivery requirement.*

In calculating the machine vs. mold break-even point, the principal variables are the costs of molds, beginning at $250.00 for a simple bushing and running up to $12,000 or more for a multiple cavity mold. Labor costs per machined part are pretty much constant and tooling costs almost negligible. On automatic screw machine or stamped pieces, the labor costs are also negligible, and the principal cost factors become simply the cost of the stock and the amount of stock removed as waste.

The following are recommended as minimum economic molding runs for various types of parts, based on current practice under average conditions.

100 to 500 pieces: For parts up to ½ oz., of relatively simple contour, such as a hat-type bushing or wide flange cylindrical electric coil form. (A number of molders are now specializing in such short run orders, using miniature molding machines and single-cavity molds.)

1000: For parts up to 2½ oz., such as roller guides, idler wheels, coarse tooth gears.

1000 each run; 10,000 total run: For larger short order parts, rerun with enough frequency to amortize mold over total run—such as combination gears.

2500: For small parts which require finish machining after molding, such as special fasteners with close tolerance threads.

2500 to 5000: For somewhat more complex parts, such as bushings with integral clips, produced in "family molds." (Molders specializing in this technique insert a single cavity for the short run part into a regular multiple cavity base being used to run another part.)

5000 to 10,000: For Teflon TFE pieces, regardless of size, because compression molding is used, followed by sintering.

10,000 to 100,000: For medium-tolerance parts, like dovetail-shaped bearings where machining after molding is required. The lower end of the quantity refers to the usual plastics, the upper end for Teflon TFE parts where sharp, accurate shoulders and other dimensions are impossible to achieve because TFE tends to "slump" during the sintering process.

20,000: For parts molded to extra-close tolerances (closer than ±0.003 in./in. or less, plus ±0.001 in. for each additional inch in length or diameter).

20,000 to 50,000: For parts with hard-to-mold

Five case histories: To the right and on the following page are charted the results of the costing out of five actual production parts by molders, machine, and stamping shops. In all cases there was no additional charge by molders for purging the machines or for setup time. These charges are included in the part cost. Nor was there any added charge for special tools or setup time by the machine shops. These were included in part cost.

*Vice President, Manufacturing, Cadillac Plastic & Chemical Co., Detroit, Mich.

that is the question

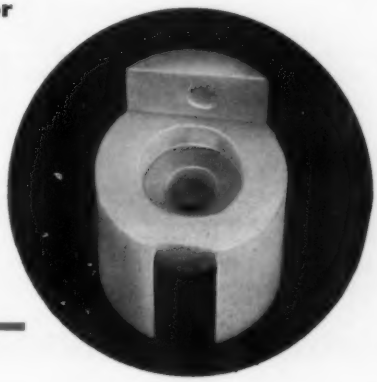
FIVE PARTS: costed out by method and quantity

1. Nylon Thrust Washer (0.090 in. OD).

QUANTITY	MOLDING TOTAL COST (*Mold cost $320 for 2-cavity, amortized over run*)	MACHINING TOTAL COST (*No tool cost*)	
2,000	$434.00	$107.00	
5,000	545.00	227.50	
100,000	4,829	4,550	*(even point)*
One Million	45,320.00	45,500.00	

2. Polystyrene Electronic Equipment Insulator

QUANTITY	MOLDING TOTAL COST (*Mold cost $430 for single cavity mold, amortized over run*)	MACHINING TOTAL COST (*No tool cost*)	
50	$484.00	$211.00	
200	646.00	514.00	*(even point)*
300	754.00	771.00	
400	514.00	1,028.00	

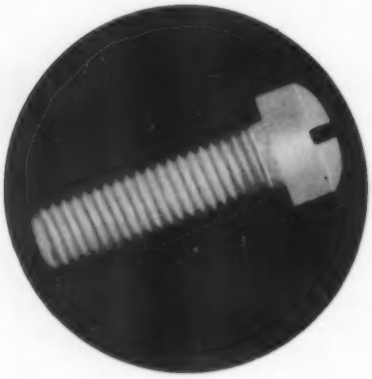


3. Horseshoe Clip Of Nylon

QUANTITY	MOLDING TOTAL COST (*Mold cost $1320 for 12-cavity, amortized over run*)	STAMPING TOTAL COST (*No tool cost*)	
60,000	$1,620	$ 738.00	
100,000	1,820	1,230	
150,000	2,070	1,880	
160,000	2,120	2,003	
170,000	2,170	2,126	*(even point)*
180,000	2,220	2,249	
300,000	2,520	3,690	

4. Delrin Stove Bolt

(1½ in. long)



	QUANTITY	MOLDING TOTAL COST (*Mold cost $450 for single cavity, amortized over run*)	TURRET LATHE TOTAL COST (*No tool cost*)
	400	$538.00	$160.00
	500	560.00	200.00
	1,000	660.00	400.00
	1,500	670.00	600.00
	1,600	674.00	640.00
	1,700	688.00	680.00
(even point)	1,800	702.00	720.00
	1,900	716.00	760.00
	2,000	730.00	800.00

	QUANTITY	MOLDING TOTAL COST	SCREW MACHINING TOTAL COST
	2,000	730.00	$440.00
	3,000	870.00	660.00
	4,000	1,010	880.00
	5,000	1,150	1,100
(even point)	6,000	1,290	1,320

5. Teflon Bushing

.807 OD plus/minus .004 by Id. .250 x ¼ in. Thick

QUANTITY	MOLDING TOTAL COST (*Mold cost $295, amortized over run*)	MACHINING TOTAL COST (*No tool cost*)	
1,000	$446.00	$188.60	
2,000	598.00	272.20	
3,000	749.50	465.80	
4,000	901.00	654.40	
5,000	1,102.50	883.00	
6,000	1,242.00	1,059.60	
7,000	1,384.50	1,234.20	
8,000	1,427.00	1,410.80	*(even point)*
9,000	1,569.50	1,587.40	
10,000	1,690.00	1,776.00	

contours requiring molds with cams, or requiring hand labor during molding cycle (blind holes, reverse tapers, internal threads, threads on parting line, undercuts, etc.).

200,000 to 1,000,000: For parts such as thrust washers, spacers, idler wheels, rollers, or pins which can readily be produced from rod stock by automatic screw machine. Automatic machining should be considered for parts involving turning, milling or cutoff, whenever quantity exceeds 500. Also for parts which can readily be produced from flat strip by blanking or punching, such as thrust washers, horseshoe clips, electric coil ends.

Whether in automatic machining or in blanking, the principal limiting factor is the amount of waste involved in part design. Labor and tooling costs per piece are virtually negligible. On round bearings or shafts or symmetrical spacer strips, involving virtually no stock removal, automatic machining is practical for almost unlimited runs. On parts requiring a great deal of stock removal as in extra large holes or sharp changes of contour, or a wasteful stamping pattern as in odd-shaped spacers, the maximum economical machine run would be considerably reduced from the figures cited above. **(To page 185)**

PROGRESS in styrene–acrylonitrile copolymers

Despite premium price, resins are moving into many new markets where their properties bring many product advantages. Processing conditions are standard, and GP polystyrene molds can be used

By Arnett L. Bird*

TELEPHONE HANDSET transmitter cup (in colored square) for Western Electric is molded of styrene acrylonitrile copolymer; its high strength permits molding around metal inserts.

Copolymers of styrene and acrylonitrile have been available to plastics fabricators for the past decade, but volume is still comparatively small—probably somewhere in the 10 to 20 million lb.-per-year area. This volume can be considerably increased—and not necessarily at the expense of other plastics. A better understanding of how the copolymer will perform and judicious use in suitable applications may well give molders ideas concerning its adaptability in new fields where competition is less severe and profits could be improved.

There are now three producers of styrene-acrylonitrile copolymer molding materials.[1] The price is 40½¢/lb. in quantity lots which, of course, is higher than general purpose or impact polystyrene. This price is generally cited as the most common reason why volume is low in comparison with the 21½¢ g. p. or 28¢ impact polystyrenes. Insofar as metals or wood are concerned, Tyril is generally less costly when used on a large-volume scale and, furthermore, requires less finishing. It can also be pointed out that molders who concentrate on specialty items frequently operate on a better profit return than those whose credo is mass production. And it could be possible that a molder would make more profit on processing, say 15,000 lb. of Tyril than on 20,000 lb. of polystyrene, with handling time and manhours saved amounting to a considerable sum, to say nothing of a better spread between actual cost and selling price.

What are prospects for price drop?

If Tyril is to follow the price history of most other plastics, price reduction is also possible when volume increases. Who knows when some large volume application may make this possible? Also the price of styrene monomer has now declined to an 11¢ or 12¢ range, and acrylonitrile monomer is down to a 25¢ to 28¢ level, which is far below the level at which it started. Production of Tyril is far more costly than polystyrene, however, and no one is expecting a price decline that will ever compare with the straight polystyrene polymers or modified impact polystyrenes.

The most important properties that have

*Customer Service Engineer, Plastics Technical Service, The Dow Chemical Co.

[1]Dow, which makes them under the tradename Tyril; Union Carbide Plastics Co., which produces them under the designation Bakelite C-11; and Foster Grant, which makes them under the Fostanitrile label.—Ed

PAINT-BY-NUMBER set, made by Palmer Pan, uses styrene-acrylonitrile for containers for the tiny jars of water colors that come with each set. Chemical resistance, transparency, and toughness helped to dictate the choice.

made Tyril effective in many applications are its dimensional stability, chemical resistance, and greater toughness over g. p. polystyrene.

Dimensional stability means that a product will hold its shape under a wide range of temperature and humidity conditions. The linear coefficient of thermal expansion of Tyril is 3.6 $\times$ 10^{-5} in./in./°F. Its critical stress in air or water is approximately three times greater than that for general purpose polystyrene. This higher critical stress and improved chemical resistance make the material suitable for applications not recommended for polystyrenes.

Particular examples of applications requiring stability are fan blades in room air conditioners, where the blades must be in balance to resist the centrifugal forces encountered in high-speed operations. The material is often used in frost-free refrigerators, where its stability is necessary and general purpose polystyrene is not strong enough.

Its resistance to chemicals includes oils, particularly those found in foods. Most notable of these is butter fat and milk or milk-derived products. Polystyrene cannot be recommended for dairy products because of crazing problems, but the effect on Tyril is considerably less. This makes it particularly useful for butter dishes and containers for cottage cheese or other foods. It makes a good breakfast bar door because of resistance to bacon grease as well as other meats, and is suitable in blenders because it is strong and resists oils and greases.

Another angle of oil resistance is also of importance. For example, brush backs, where straight polystyrene may be affected by soaps and hair oils, can be effectively molded of styrene-acrylonitrile. In addition, Tyril is more resistant to splitting when bristles are stapled in. At one time, hair curlers were predominant in this type material because of strength and oil resistance. But they have partly given way to lower cost materials, although one prominent manufacturer still uses them with a special, higher-cost line.

Chemical resistance against acids and alkalies has long been a featured property of

QUALITY CARAFE SET is made of styrene-acrylonitrile copolymer because of the material's chemical resistance to coffee, fruit juices, tea, etc.

WATER FILTER BOWL must contain pressures as high as 150 p.s.i. Good toughness in thin gages made Tyril suitable for this application.

styrene-acrylonitrile copolymers. Wet cell battery cases were one of the first and largest applications for this reason.

Appliance parts such as the lint filters in a washing machine that fits on top of the agitator shaft is another example since it resists detergents, soap, etc. Typewriter keys that resist staining from cleaning fluids is another use.

Another type of resistance to corrosion is found in a molded transmitter cup in telephone hand sets where Tyril does not contribute to carbon poisoning that causes background noise or static. The material is tough enough to permit molded-in metal inserts in many applications, including the transmitter cup.

Still another application is occasional dinnerware where resistance to cottage cheese, butter, and coffee staining is desirable. It overlaps with impact styrene in this case and is used generally as a higher cost item.

HOT DOG COOKER was specified in styrene-acrylonitrile because material resists greases and fats, has high heat distortion point, and, particularly important, it can be molded around electrodes without stress cracking.

The material is tough

Tumblers, molded of styrene-acrylonitrile copolymer, will last 5 to 10 times longer than those molded from g.p. polystyrene and in addition are resistant to butter fat content of foods such as milk, and can be washed in most dish washers. For tumblers, Crystone colorant is added to give a blue tint to simulate glass. Without it, styrene-acrylonitrile copolymers have a yellowish cast.

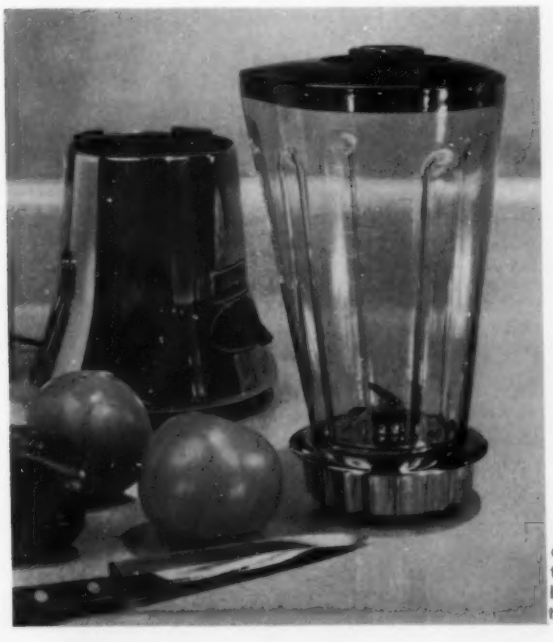
This material is also tough enough to use in screw caps—it doesn't crack around the threads as most thermoplastics sometimes do. Its heat distortion is about the same as high heat resistant polystyrene, 214° F. compared with 175° F. for g.p. polystyrene.

Tyril can be processed in molds built for g.p. polystyrene, since mold shrinkage is approximately the same (0.002 to 0.006 in./in.). The normal range of cylinder temperatures is 400 to 550° F., which are in general about 50 to 75° F. higher than g.p. polystyrene employing comparable machine pressures.

Controlled mold temperature is important. If the mold temperature is 170 to 190° F. (or higher) the moldings will exhibit maximum heat resistance and minimum tendency to craze. Heat resistance will decline if mold temperature is too low. Excessive high pressure in the mold causes sticking and cracking. Sink marks and bubbles result when the plastic is too hot.

The largest piece of styrene-acrylonitrile copolymer molding from a weight point of view is a battery case weighing approximately 15 lb. but in geometric size the largest is probably a refrigerator hydrator shelf that weighs about 1½ pounds.

A list of typical uses up to now includes tumblers, coffee cups, pitchers, dinnerware, cutlery handles, bristles, oil and water filter bowls, rigid food containers, closures, pen and pencil barrels, medical equipment components, aerosol nozzles, fan blades, terminal boxes, appliance legs, and furniture legs.—End



BLENDERS MOLDED of styrene-acrylonitrile resist citrus, alcohol, and dairy food chemicals. They come transparent and in range of colors. Because they can be produced in thinner gages, they are less expensive than glass unit—and shipping costs are lower.

Thermal liquid cure speeds

A liquid slush molding process which fuses plastisol at temperatures 200 to 250° below those found in hot air cure methods has enabled a manufacturer of marine buoys to cut up to 60% off the cycle time needed for such items. With the new process, Oshkosh Plastic Products, Inc., Oshkosh, Wis., turns out buoys which retail at prices comparable with other types but whose corrosion-free, long-life properties result in significant savings to users.

Heart of the process is a special 36-in. liquid medium rotational oven produced to Oshkosh Plastic's specifications by the E. B. Blue Co., South Norwalk, Conn. This equipment and its lower curing heat offer these advantages, says Oshkosh: 1) longer mold life with less distortion; 2) indicated longer life for the oven itself; 3) easier working conditions for, and less training required by, the operator.

The buoys—20 in. in diameter and 34 in. high—are molded of Thermasol, supplied by Lakeside Plastics Corp., also of Oshkosh. Thermasol, a modified casting plastisol with semi-rigid properties, is formulated to provide high impact strength.

The plastisol shells of the buoys are molded around a rigid vinyl tube which in the finished products provides a channel for a mooring chain or for the screw-on plastisol-coated hardware with which some models are fitted. Molding time is approximately 40% to 50% that which would be needed in the more conventional hot air process.

How buoys are molded

The buoys are molded in aluminum molds manufactured expressly for slush casting by Mold Craft, Inc., Port Washington, Wis. First step is to fix the rigid vinyl channel tube in the bottom part of the mold. Then a measured weight of Thermasol is poured into the bottom of the mold, an aluminum plug is fitted into the top of the vinyl tube, and the upper part of the mold clamped into position.

The mold, clamped into its agitating jig, is rolled into the thermal liquid chamber for the fusing stage, and then, on the same jig, passes on into a circulating water quencher. Relatively low-temperature fusing appreciably shortens the period needed to bring the plastisol shell down to the 135° level at which it can be extracted from the mold.

Foam adds strength, buoyancy

After molding, the one-piece plastisol shell of the buoy is filled with a high density, rigid type polyester urethane foam. This is introduced under pressure and foamed in place. It increases the structural strength of the buoy and contributes desirable flotation properties. The urethane foam is supplied by Freeman Chemical Co., also of Port Washington.

Although all Oshkosh buoys are of the same size, they are manufactured in several forms: mooring buoys, with or without plastisol-coated steel rings at each end; racing or marking buoys with special recess for flag or marker; and a lighted buoy with battery-powered beacon. Except for the lighted type, models retail in the $45 to $50 range, depending on type of hardware supplied.

Air drops test strength

For its urethane-filled plastisol products Oshkosh claims a number of advantages over buoys made of other materials:

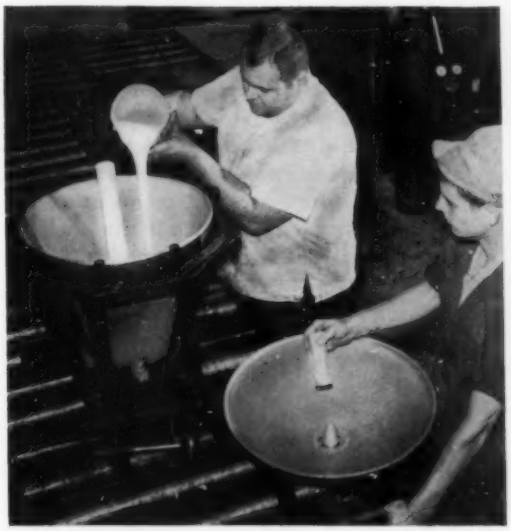
1) Extreme ruggedness. Buoys have been undamaged by test drops into a lake from aircraft flying at 1000 and 10,600 feet.

2) Economy. Although initial cost is comparable to that of previous buoys of similar size and purpose, savings accrue from the plastic buoy's longer life and greater resistance to damage. The plastic buoy is impervious to corrosion in either salt or fresh water. Furthermore, it will not mar boat hulls.

3) Greater visibility. The Thermasol from which the buoys are molded comes in a range of colors; Oshkosh has chosen white and fluorescent hues of red and yellow.—End

plastisol molding

Manufacturer of marine buoys achieves 60% saving in cycle time by substituting for the conventional hot air oven cure a heated-liquid system to fuse the material

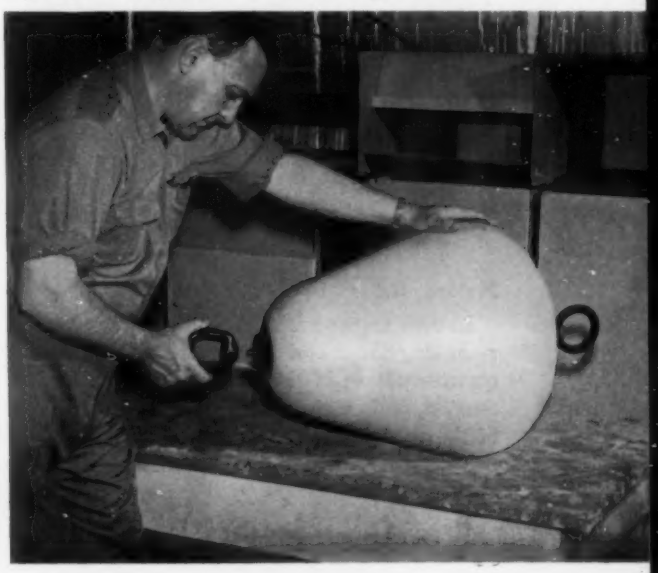


MOLDING STARTS with pouring of a measured weight of the plastisol into base of two-part mold. Vinyl tube preset in mold extends through center of finished product.

ASSEMBLED MOLD, of aluminum, is placed in 36-in. slush molding oven. Equipment uses a thermal liquid rather than hot air to fuse vinyl plastisol material.

AGITATING JIG carries mold from fusing chamber to circulating water quencher. Relatively low temperature of thermal curing liquid permits quicker cooling to 135° F., at which shell can be extracted from mold.

MOLDED SHELL has been filled with liquid polyester urethane which is foamed in place. Final assembly is fitting of plastisol-coated hardware. Rod extends through vinyl tube in buoy to receive bottom ring attachment.



RP molds bring 85% die cost

Conversion of stock cars to special-purpose vehicles is made economically feasible through use of reinforced polyester parts molded on reinforced epoxy molds

Conversion of standard automobiles to ambulances, funeral coaches, and similar vehicles has turned from sheet metal to fibrous glass reinforced epoxies for production molds.

The reason: sheet metal components of today's car bodies are too complex to permit economic handworking of metal to allow for the necessary extension, roof build-up, rear door, etc. Thus, in order to use metal, dies to stamp out the parts would be needed. Cost of such dies is estimated to be in excess of $250,000 and a production of at least 1000 vehicles per year would be required to make their cost economical. Annual production of car converters is generally far below this figure. The Shop of Siebert, Waterville, Ohio, whose vehicles are illustrated on these pages, makes fewer than 500 a year.

How cars are converted

The solution to this economic dilemma was found in reinforced plastics, which were used both for the molds and the actual parts. Cost for the molds was up to 85% less than that of the metal dies; and by using reinforced plastics as the material of construction, it was possible to follow the styling of the car that was being converted (in the illustrations, a stock Ford station wagon). During the conversion process, the stock car is lengthened by approximately 3 ft., the roof is built up, and a rear door added. While the labor cost in RP molding is appreciably higher than for metal stampings, this is more than made up for by the low cost of the molds.

Making the molds

In making the mold, the first step consists of removing the metal roof, cutting the side and quarter panels of the car to allow for the extension, and cutting away a section of the rear of the vehicle for the future door.

Next, a wooden "buck" is constructed in the open areas upon which is fashioned a clay model. Following this step, a water soluble parting agent of polyvinyl alcohol and wax is sprayed on the clay.

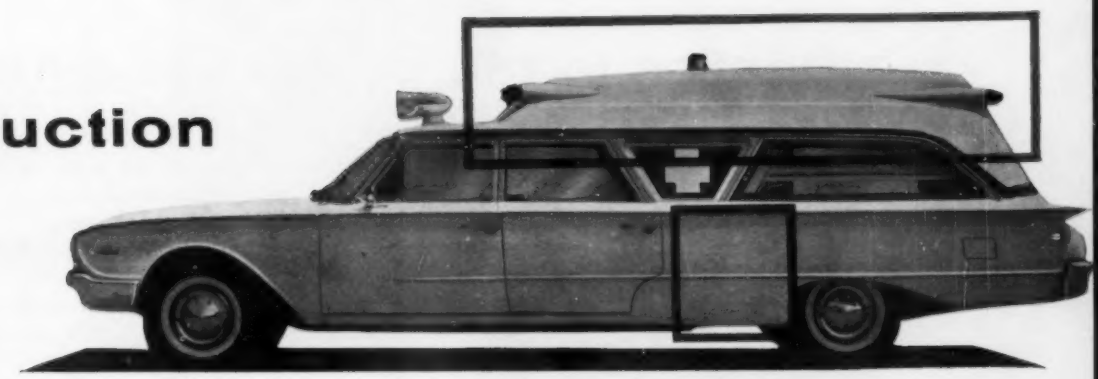
Epoxy resin, supplied by Rezolin Inc., Santa Monica, Calif., and successive layers of fibrous glass cloth and mat are laid up to bring the mold to the desired thickness. The mold is ready for use after a wooden frame is attached and the clay has been removed. When the mold is inverted so that the actual molding operation can begin, the frame supports the mold.

The parts for the converted vehicle are then produced in these RP molds, also using the hand lay-up method. Plaskon polyester resin, supplied by Allied Chemical Corp., New York, N. Y., and successively three layers of 2-oz. fibrous glass mat and three layers of fibrous glass cloth are placed into the female mold and cured at room temperature. Fibrous glass is

THREE STEPS

FIRST STEP in conversion of automobile consists in cutting away metal and constructing wooden buck for roof, side, and quarter panel extensions as well as the rear door. Clay model is eventually built up on this framework.

reduction



supplied by Owens-Corning Fiberglas Corp., New York, N. Y.

All parts are attached to the car body mechanically. Seams along the sides are filled with polyester-glass and smoothed down to give the appearance of one-piece design.

Volume is relatively small

The total market for such car conversions is 2000 per year. Because of this relatively small volume, RP molds and molding are the most economical production technique. No cost comparisons with Detroit-produced ambulances can be made, since none of the major automobile makers produces such vehicles.

The success of the technique indicates its applicability to other small volume applications involving structural changes of major pieces of equipment, in transportation, construction, and other areas.—End

SLEEK AMBULANCE, top photo, started out as a plain Ford station wagon. Body-lengthening panel and built-up roof marked in color are made of reinforced plastics on reinforced plastics molds. Rear door, shown in the photograph above, is similarly molded.

IN MAKING RP CONVERSION MOLD

ROUGH CLAY is applied to wooden buck to form basic mold contours outlined by plywood template. Clay is then smoothed and sprayed with mold release agent. Mold is produced by hand lay-up of fibrous glass and room curing epoxy resin.

AFTER MOLD HAS BEEN completed, strong wooden framework is attached. It serves as support when the mold is lifted off and inverted for the molding operation. Since such conversions are relatively small, RP molds are most economical.

Plastics in the product revolution:

IDEAL TOY'S lifelike Peter Playpal (center) is 38-in. vinyl-PE walking doll that retails for $35. Eyes, hair, and lashes are also plastic.

To anyone who has seen the variety of beautiful dolls being produced by American manufacturers, it is obvious that plastics and doll making have become as inseparable as Toulouse and Lautrec or Rimski and Korsakov.

This was not always the case. The earliest plastics offered almost as many disadvantages as advantages to the doll designer. But with the advent of vinyl for heads and arms; polyethylene and vinyl for torsos and legs; cellulose acetate butyrate for eyes; nylon and saran for eyelashes; saran and acetate for wigs (hair); an assortment of plastics for clothing and accessories (nylon, PE, styrene, vinyl, and acetate); and acetate and PE for packaging; the inevitable fraternization between plastics and the doll industry became a reality.

Plastics not only created more lifelike and attractive dolls, but also made possible the talking, walking, crying, and wetting dolls that are so cherished by the Junior Miss. When blow-molded PE entered the scene in 1959, a new era of large, handsome doll bodies—produced faster and more economically than their predecessors—came into being; and, with the blow-molding of vinyl just around the corner, even more significant advances are anticipated.

Although members of the highly competitive doll-making fraternity are not given to much talking, it is no secret that the business consumes millions of pounds of plastics annually. Since reliable statistics on plastics consumption by the doll industry are not available, a conservative guesstimate is in order: 20 million little girls in the U. S. $\times$ an average of two dolls a year per child $\times$ an average of 2.5 lb. of all plastics per doll $=$ 100 million lb. of the various resins that are used for dolls, accessories, and packaging.

Plastics usage per doll

To be more specific, Lawrence Doppelt, vice president of Goldberger Doll Mfg. Co. Inc., Brooklyn, N. Y., had this to say: "During the height of our season, we make about 300 dz. (3600) 32- to 36-in. dolls a day. A 32-in. doll takes about 2½ lb. of polyethylene for the body and legs, and approximately 2 lb. of vinyl for the head and arms. In other words, we use about 15,000 lb. of these plastics a day for these size dolls."

Goldberger, a 40-year veteran of the industry, has 150 kinds of dolls, ranging in sizes from 8 to 36 in., in its Eegee line. Besides this company, there are today between 80 and 100 doll manufacturers in the United States. And 95% of all their dolls are now made of plastics. The remaining 5% is mostly rag and rubber.

Last year, according to an independent survey, dolls and accessories accounted for roughly 15% ($240 million) of the annual $1.6 billion toy business. This is more than double the 1950 figure of some $100 million. A 7% increase is expected for 1960. And since the American population continues to climb, still more millions of pounds of plastics will find their way into this market.

Prior to World War I, most dolls were imported from Germany. They were made of bisque (vitreous ceramic) and had eyes that were glass-blown shells individually fitted into the fragile heads. When the war cut off supply, American ingenuity was called upon to fill the void. The brittle bisque head was sup-

DOLLS

THE COVER: Plastics have greatly upgraded the multi-million-dollar doll industry, as evidenced by this group of Ideal Toy Corp. dolls. Only the clothing (some of which is cotton) is non-plastic. A vivid contrast to these lifelike toys is afforded by the wooden-headed doll with glass eyes and human hair (c. 1790), which is part of an exhibit at the Museum of the City of New York.

planted by a composition head consisting of wood flour, glue, and starch. But this material was easily affected by humidity, and dolls often cracked at the plant or on the store shelf. Needless to say, a supply could not be held over from season to season, and a large on-hand inventory meant a heavy loss.

First plastic doll

Eastman Chemical Products Inc. supplied Tenite cellulose acetate to the Ideal Toy Corp., Hollis, N.Y., in 1936 for what is reportedly the first use of plastics for making dolls as we know them today. After its introduction in 1938, cellulose acetate butyrate became more popular because of its greater compatibility with lacquers and because it was easier to mold.

Actually, prior to this, Celanese Plastics Co. (then known as the Celluloid Corp.) began supplying celluloid sheeting for small blow-molded dolls in the early part of the 20th Century. The company originally furnished acetate molding compounds to the doll industry in the middle 1920's, and it still provides this plastic for making small dolls such as the popularly-priced Jinny.

Goldberger began using plastics in 1946. The following chronology gives a brief summary of development:

Prior to 1946: Composition head and cloth body and limbs.

1946-1947: Injection molded butyrate head and cloth body.

1948-1949: Acetate head and Latex (foam stuffed) body.

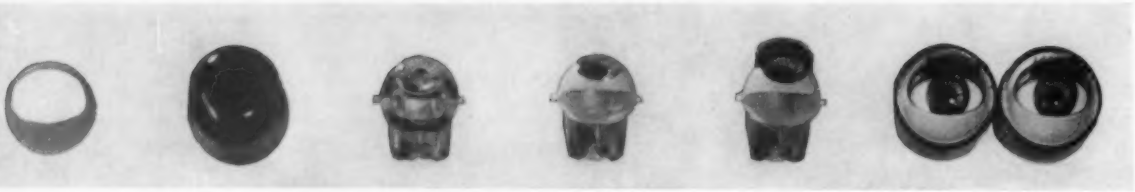
1950-1951: The vinyl plastisol head (with painted eyes) and Latex and Neoprene body. Neither acetate nor butyrate could compete with vinyl's fine detail, such as the undercut at the ear. But the early vinyl tended to absorb the lacquers and paints used in finishing the face. Prior to this, the non-plastic wig had to be attached to cloth and then glued to the head. With a vinyl head, the newly-discovered saran wig could be stitched on (rooted), allowing the child to wash and curl the doll's hair to her heart's content. However, some doll makers still use an adhesive for applying the wig.

1952-1954: Vinyl plastisol head (using moving plastic eyes), and Latex and vinyl body. Vinyl, for the first time, allowed the deep-formed eyesockets that were necessary for properly fitting the eyes. An innovation, however, was the all-acetate walking doll.

1955-1958: All previous dolls made way for the all-vinyl plastisol molded doll. The vinyl not only produced a softer, more realistic doll, but also lent itself to finer detail and finish.

1959-1960: Vinyl head and arms; blow-molded PE torso and legs. Without blow molding, the larger dolls (30 to 36 in.) would

VINYL HEAD AND ARMS and blow-molded polyethylene torso and legs create realistic 32-in. Eegee walking doll for Goldberger Doll Mfg. Co. Inc. The company has been using plastics since 1946, when an injection-molded butyrate head replaced the composition head that was formerly used. Doll's wig is acetate.



MARGON CORP. makes six types of plastic eyes for dolls and other toys. Components of the company's individual sleeping eyes are: 1) steel front cover; 2) injection-molded polypropylene back cover; 3) one-piece cellulose acetate butyrate eye shell as molded; 4) eye shell with white and flesh color applied; and 5) same as No. 4, with eyelash attached. At extreme right is a set of rolling eyes, which have more moving parts than the sleeping eyes.

be too costly to produce and too cumbersome and heavy to merchandise. Another advantage in using blow-molded PE was the fact that the vinyl buckled and required metal framing for the larger torsos. And the 36-in. walking doll, which was the top selling doll in 1959, was built around the blown torso. As yet, blow-molded PE does not permit the fine detail needed for fingers, hence one of the reasons for using vinyl.

Although American doll makers had new impetus after World War II—when new materials and machinery became available—none of these incentives has had as much impact as vinyl plastisols. Blow-molded PE, of course, brought larger dolls and new economies, but vinyl is still the champion for creating lifelike heads and arms.

Blow-molded vinyl a reality

Now that U. S.-made blow-molding machines can compete with the European models; and, since the price of plastics—especially PE—has been on the downgrade, most of the major doll manufacturers have been converted to this technique. However, F. J. Stokes Corp., Philadelphia, Pa., will soon release equipment to the doll makers which will blow mold vinyl, and another revolution is expected to be in the making.

"Producers of doll bodies ranging in size from 20 to 36 in. have found blow molding to be an efficient and economical means of production," said William A. Shilling, Field Supervisor, Auto-Blow Corp., Bridgeport, Conn. "These bodies can be produced at rates of one every 12 sec. to one every 30 sec. on two-station machines using two molds. The rates," he continued, "depend upon the wall thickness and the required quality of the body."

Many manufacturers now find it advantageous to blow-mold a doll body on one side of the press and two legs on the other. The latest model machines have a manifold which can be made to work as either two, three, or four stations; and, since two legs weigh about the same as one body, a manufacturer can run with four small size body molds, or two large size body molds, or one large size body and two legs. Accumulators now on the market offer a higher quality through more uniform wall thickness and higher production. And additional economies can be realized with the automatic equipment now available for drilling or reaming the five holes in the torso for

ALL-VINYL BABY DOLL, made by Uneeda Doll Co. Inc., has molded-in hair and plastics eyes and baby bottle. The 16-in. toy, which is sold in retail stores for $2.98, drinks, wets, and has a cooing built-in voice.

attaching arms, legs, and head. The scrap, of course, is reusable.

Keeping pace with the rapid advances made by the doll industry, much progress has been made by the eye-producing segment of the industry. Margon Corp., Newark, N. J., a leading firm in the field, began making eyes in 1918 to replace the European glass eyes. These early models had a printed celluloid shell mounted over steel cups. They were assembled in pairs, connected by a steel wire, and fitted with steel or lead weights.

"In 1924," said H. W. Samo, the company's Works Manager, "Margon developed lithographed metal eyes. The eyeballs were blanked and drawn from lithographed metal sheets, representing the iris, pupil, white, and flesh color of the eyelid. As the eyeball turned, the 'eye' would disappear and the 'lid' appear."

By 1927, eyelashes were added by inserting prepared strips of human hair imported from China. As soon as nylon became available, a 0.003-in. monofilament replaced the human hair. It was not only more readily available and more economical, but also more sanitary.

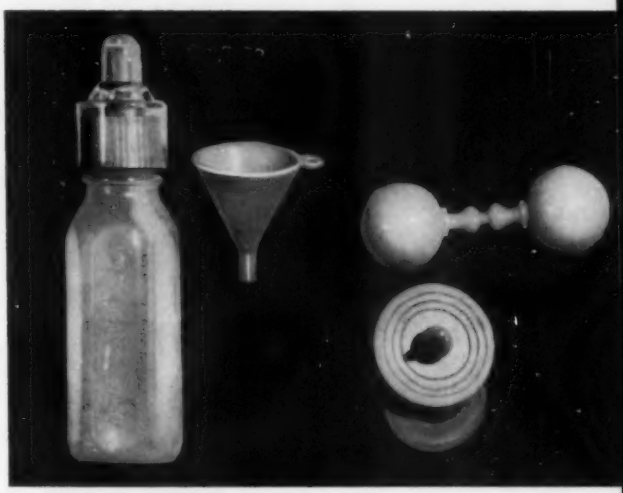
A metal eye with a celluloid iris was first produced by Margon in 1937. This iris was set into a depression of the metal eyeball; however, the iris-pupil was later changed to an injection molded part, using first cellulose acetate and later cellulose acetate butyrate. The latter combined clarity and transparency with good moldability, as well as excellent resistance to breakage, aging, and plasticizer migration. The former material accounts for 4% of Margon's present production; the remaining 96% is still cellulose acetate butyrate.

Since doll's eyes are a major component, fitted into the heads that are manufactured from a variety of plastics not under Margon's control, the compatibility of the materials is of constant concern. For this reason, Margon advises doll makers on the limits of compatibility and tests sample materials and combinations. All parts must withstand an accelerated aging test at 120° F. and 100% humidity.

"Between 1940 and 1948," Mr. Samo stated recently, "our development work led through three-part, two-part, then one-part injection molded eyeballs. The complete eyeball was injection molded in a multi-cavity mold, and the colors were applied in subsequent automatic spray machines. The design permitted automation on a large scale, and reduced the number of operations by 80 percent."

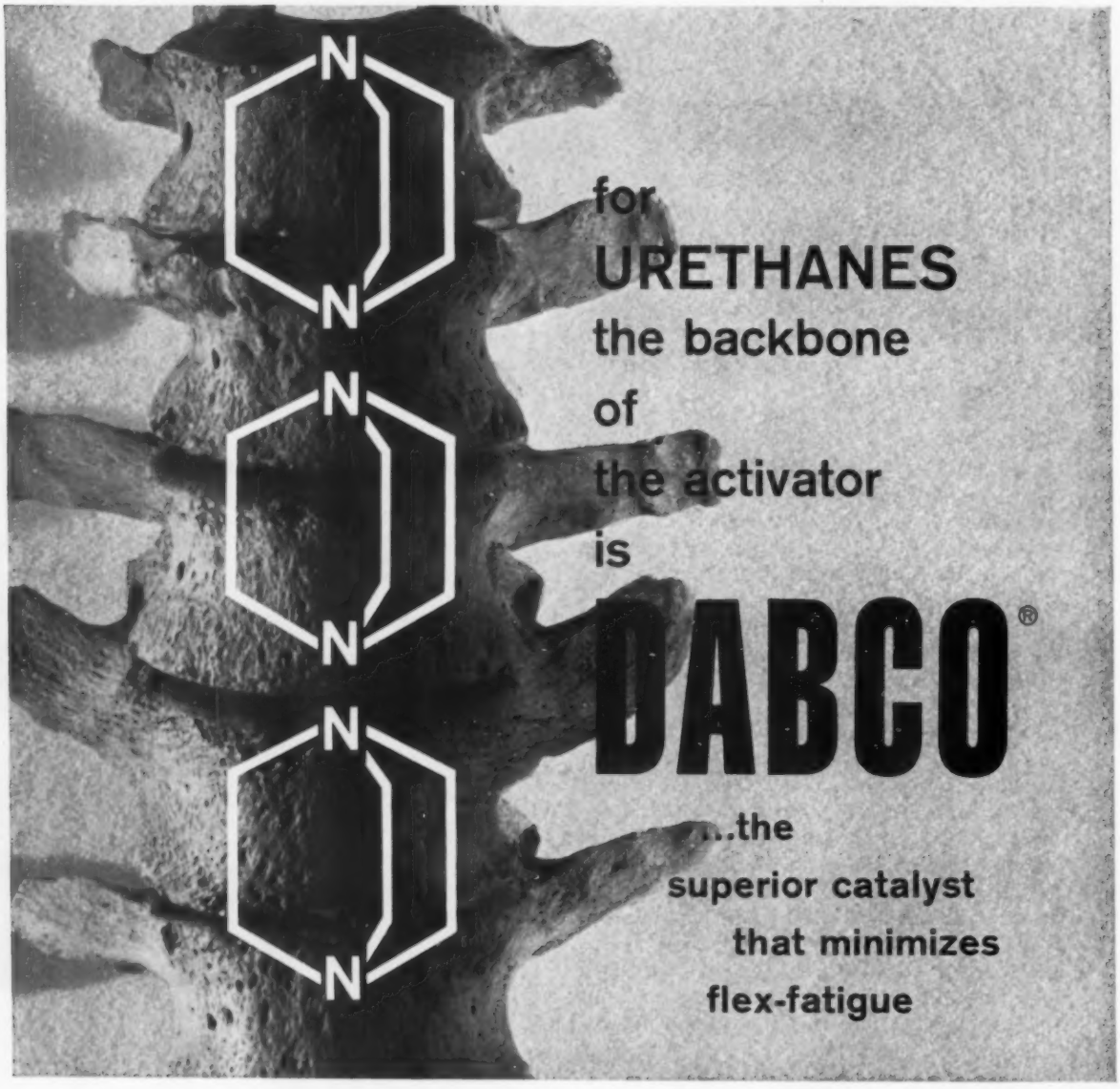
However, Mr. Samo points out, there were problems in injection molding which had to be solved: "A major problem in molding was the design limitations, which did not permit uniform wall thickness. The iris and pupil portion, for example, must be thick, while the remaining ball could only have a 0.030-in. wall thickness. This caused bubbles, sinks, and welds in the iris portion. Pingating in combination with high injection pressures and speeds overcame these drawbacks to such an extent that molds with up to 40 cavities could be run successfully with up to four different eye sizes in one mold."

Margon also automated the making of eyelashes at this time. Saran, although less resistant to heat and distortion than nylon, was adequate for this application. Also, nylon could not be obtained in spooled single ends.



PLASTICS have also made tremendous inroads into the doll accessories field. These Progressive Doll Accessories Corp. articles (with the former material shown in parentheses) are: 1) Polyethylene bottle (glass), PE nipple (rubber), PE bottle cap; 2) PE funnel (metal); 3) acetate rattle; and 4) acetate pacifier (rubber).

Up to 1940, dolls eyes were made to fit the hard acetate and butyrate heads, and they had to be custom fitted in pairs to suit center distance of a given head. With the advent of individual eyes, Margon, in 1950, developed a totally enclosed eye, one which was designed for the slush-molded vinyl heads. This also meant that Margon had to work with the doll makers to insure that the eyes could be fitted properly. Special plugs had to be attached to the inside of the vinyl head (To page 194)



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Melt extractor moves into new role— PREPLASTICATION

Adaptable to existing machines, this new preplasticating injection system can be used to increase the production rate and part quality

By Albert Spaak

The author: Albert Spaak is a native of New Jersey and graduated from the Newark College of Engineering as a mechanical engineer. After 19 years as Chief Engineer for De Mattia Machine & Tool Co. and Mastro Plastics Corp., he joined W. R. Grace & Co., in 1957, and is now Manager of Engineering in the Technical Service Department of the Polymer Chemicals Div. He is current President of the S.P.E., Newark Section, and resides in Little Falls, N.J.

*Reg. U.S. Pat. Off.

[1]U.S. Patents Nos. 2,860,375 and 2,895,167 and pending U.S. patent applications; French Patents Nos. 1, 137, 455 and 1,137,456; British Patents Nos. 1, 137, 455 and 1,137,456; British Patents Nos. 774,056 and 774,061; Japanese Patents Nos. 237,393 and 237,480; German Patents Nos. 27,550 and 27,707; Italian Patent No. 23,393.

The melt extraction heating cylinder has for years been successfully used at the Mastro Plastics Corp. on most of its tile injection molding machines. Eight-cavity molds for 4¼ by 4¼ by 0.046 in. thick tiles, with a total projected area of 148 sq. in., run on cycles averaging 10.5 sec. in 275-ton Reed-Prentice machines using only about 80% of the injection pressure capacity.

During the past 18 months, a unique new injection machine design[1] has been conceived, developed, and placed in production by Mario Maccaferri, president and founder of Mastro Plastics. The design utilizes the melt extraction heating cylinder as a preplasticator in a straight-line injection system.

The following article describes the design of the new machine, analyzes the advantages of such a system over conventional injection molding machines, and presents field data on plastics used.

How it works

A diagram of the Mastro Straight Line Melt Extractor Pre-Plasticator is shown in Fig. 1, below. The entire injection unit is mounted on a movable table *1*, in the diagram, and rests on the two blocks, *2* and *3*, which are rigidly fixed to the table. The injection system itself consists of the heated, fixed accumulator injection cylinder, *4*, and the movable preplasticating cylinder, *5*. The front end of the preplasticating cylinder is designed to act as the shooting piston, as indicated by designation *6*, which forces the

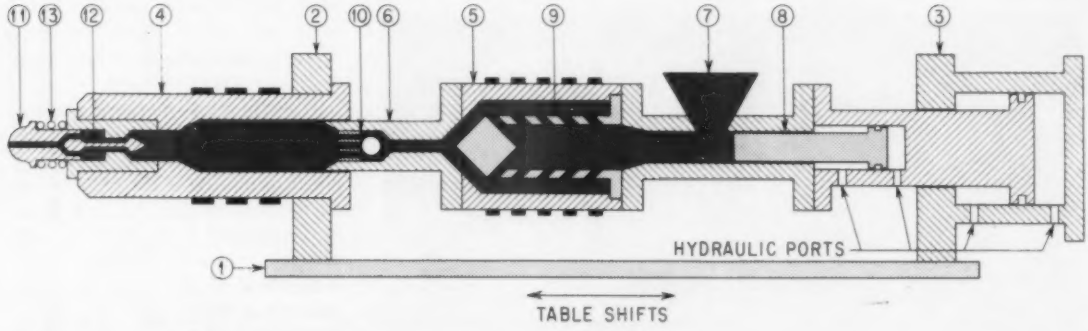


FIG. 1: Schematic diagram of Maccaferri melt extractor preplastication system. Function of numbered parts is explained in text. Table shifting mechanism is not shown. Color indicates material flow.

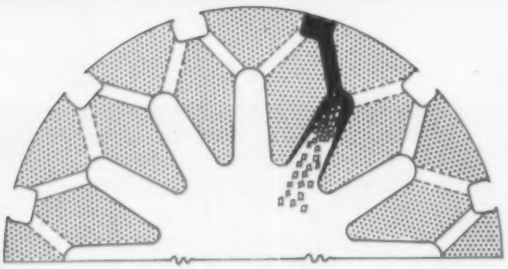


FIG. 2: Cross section of melt extractor torpedo or cylinder liner showing how pellets are exposed to larger area heating surfaces.

plastic from the accumulator into the mold.

In operation, plastic granules fall from the feed hopper, *7*, into the throat of the preplasticating cylinder, *5*. A hydraulic stuffing piston, *8*, moving with short strokes, is used to advance the granules into the heating chamber which is equipped with a Maccaferri type melt extractor, *9*. A cross-section drawing of the melt extractor illustrating its operation is shown in Fig. 2, above, and a photograph of the actual preplasticating cylinder with the melt extractor disassembled is shown in Fig. 3, below.

After the material has passed through the preplasticator, the hot melt, under the action of the stuffing ram *8*, passes through a ball-check valve, *10*, (shown open) in the ram end of the preplasticating cylinder (*5*) to the accumulator cylinder (*4*). While the accumulator is filling with hot melt, the injection nozzle, (*11*) is shut off by the nozzle valve (*12*) (shown open). This valve is held closed, as the accumulator fills, by the spring (*13*). Pressure from the hot melt being stuffed into the accumulator also aids in keeping this valve closed. During this filling process the movable table, *1*, is at the right end of its travel in Fig. 1.

As the accumulator is being filled the preplasticating cylinder's ram, *6*, backs out of the accumulator in accordance with the volume of material being packed into the forward chamber.

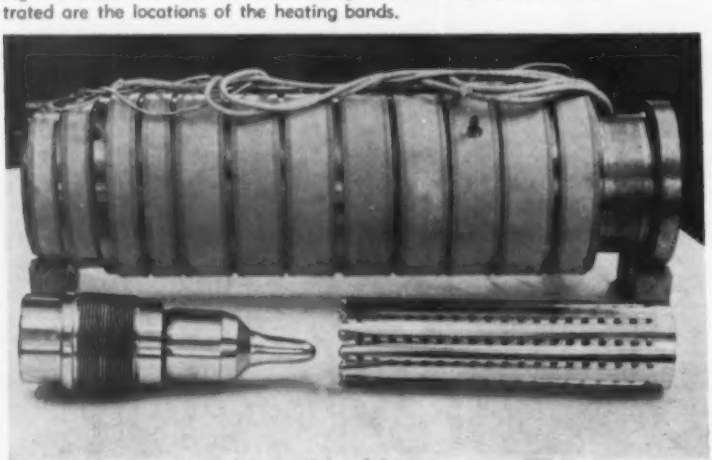
When the required amount of hot melt has been stuffed into the accumulator, the stuffing action is stopped, and the movable table, *1*, advances to the left in Fig. 1 enough to open the nozzle valve (*12*) against the spring action. Simultaneously, the preplasticating cylinder advances to the left in Fig. 1, and its ram develops the pressure in the accumulator cylinder which injects the material into the mold. The ball check valve, *10*, prevents the melt from back-flowing.

After the mold is filled, the movable table retracts to the right in Fig. 1, closing the nozzle valve (*12*), and cutting off plastic flow through the nozzle. The stuffing action of the ram (*8*) is started again and the entire sequence is then repeated for the next cycle.

The accumulator does little, if any, plasticating. Its chief function is to act as a holding chamber for the hot, homogeneous melt.

A significant feature of the preplasticating system is that it can be incorporated into existing machines with little trouble. All that would be required is 1) a minor repiping of the hydraulic system to operate the stuffing and shooting cylinder and table shift and 2) rewiring to provide the proper valve action.

FIG. 3: Preplasticator cylinder with melt extractor disassembled, showing construction of the liner and the spreader on the left. Also illustrated are the locations of the heating bands.



Melt extractor as a plasticizing device

There are three distinct operations in preplasticating systems: first, the plastic is melted; next, it is transferred to an accumulator chamber; third, the material is injected into the mold. Of paramount importance to the success of the system is the efficiency of the cylinder in which the preplastication takes place.

When melt extractors were first introduced, (1), (3)[2] their performance varied and became the subject of some controversy. Some applications succeeded while others have shown no marked improvement over standard heating cylinder designs. Analysis of the problems encountered indicates that size of the cylinder bore is the important factor. If the characteristic cold granular core in the center of the melt extractor becomes excessively large and unyielding, the plasticating capacity and through-put fall off because of pressure losses. It has been found that for cylinder bores 3½ in. and under, this is not a major problem, and plasticating efficiency is increased using the melt extractor design. In fact the granular core has an advantageous venting effect, allowing occluded air in feed to escape.

If bore sizes are increased additional heating is needed to decrease the granular core's resistance. Development work is being done on larger bore cylinders using a heated spreader internally to reduce the core effect.

When properly designed and applied the melt extractor can be made very efficient. A maximum plasticating rate is obtained by repeatedly removing the thin layer of plasticated melt next to the heating cylinder surface. The importance of spreading the plastic into a thin layer is demonstrated in Fig. 4, right, which

[2]Numbers in parentheses link to references at end of article, p. 199.

compares the amount of time required to melt various thicknesses of several materials. Curves were obtained by measuring the time for 1 in. square samples of various thicknesses to melt on a hot plate under pressure. The melting rate decreases rapidly with increasing thicknesses because of the low thermal conductivity of the various plastic materials.

Comparative studies at the Grace laboratories made on melt extractor and conventional cylinders further substantiate the better efficiency of the melt extractor. Data on a heating cylinder efficiency using the same machine, with and without the extractor, is shown in Fig. 5, below, for polystyrene. Cylinder efficiency, E_c, is defined as:

$$E_c = \frac{T_a - T_o}{T_i - T_o} \times 100 \qquad \text{Eq. 1}$$

where T_a is average stock temperature at the nozzle, T_i is temperature of the cylinder wall, and T_o is the initial temperature of the entering plastic. Note that at any given production rate the extractor was considerably more efficient. The difference decreases at lower rates since retention time becomes more than adequate for thorough heating even in the conventional cylinder.

In addition to measuring cylinder efficiency, thermal or machine efficiency E_m, was defined as:

$$E_m = \frac{\text{Heat output, B.t.u.}}{\text{Heater input, B.t.u.}} \times 100 \quad \text{Eq. 2}$$

The heat output or heat content of the plastic leaving the nozzle was calculated from heat content[2] (enthalpy)-temperature curves for high-density polyethylene and polystyrene. Input was calculated from the power input of the electrical resistance heaters. Results of measurements on the two types of cylinders and materials are shown in Fig. 6, below. Again the melt extractor was found superior indicating less power or heat input was required to maintain a given plasticating rate, as well as to deliver material at a given temperature.

This information is restated in Fig. 7, p. 110, which presents it in a somewhat different way. For example, if a material temperature of about 410° F. is desired, the conventional cylinder temperature must run at 500° F. Output is about 55 lb./hr. of polystyrene. Using the melt extractor, a 410° F. stock temperature also requires a 500° F. cylinder; however, the output has risen to 75 lb./hr. allowing the machine to run on a 37% faster cycle. Remember, however, that total plasticating capacity is not always the limiting factor in the output of a machine. The cooling required for certain parts and other influences on cycle will also help determine the maximum rate which can be obtained on a given job; which rate may not fully utilize the plasticating capacity available.

The above evidence clearly shows the higher efficiency of the melt extractor compared to the conventional torpedo type cylinder. It also makes a better preplasticating cylinder.

[2]Heat content above a given temperature is equal to the specific heat of the material multiplied by the temperature differences above the reference temperature. This assumes specific heat does not vary with temperature. If it does, small increments must be summed to obtain an accurate estimate of heat content.

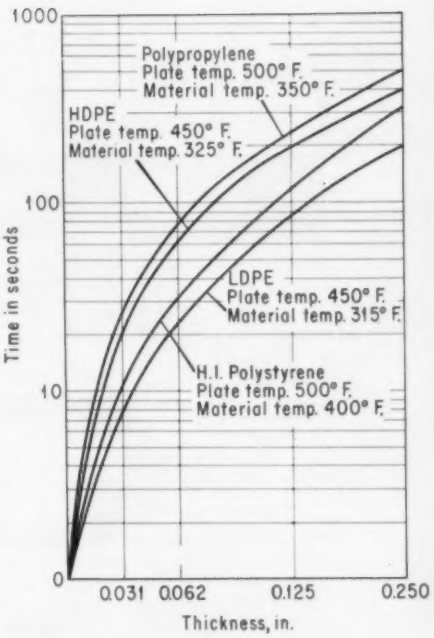


FIG. 4: Time to melt samples of varying thicknesses (on a hot plate under pressure) as a function of sample thickness. Curves are for polypropylene, high-density polyethylene (HDPE), high impact (HI) polystyrene, and low-density polyethylene (LDPE).

Improved homogeneity

In addition to the better thermal performance the melt extractor has other advantages. When operated with short strokes only fully plasticated material passes through the extractor. As it does so, the material is subject to mixing and shearing action which serves to fully homogenize the

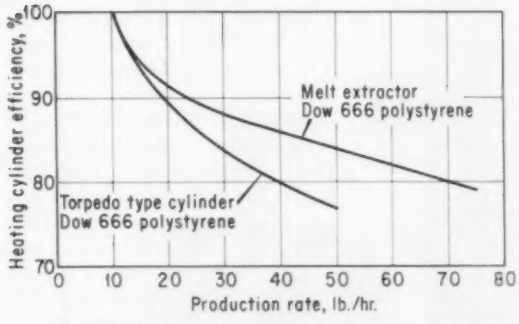


FIG. 5: Heating cylinder efficiency as a function of production rate; for polystyrene in torpedo type and melt extractor cylinders. Heating cylinder efficiency is defined by Eq. 1 shown in the text above.

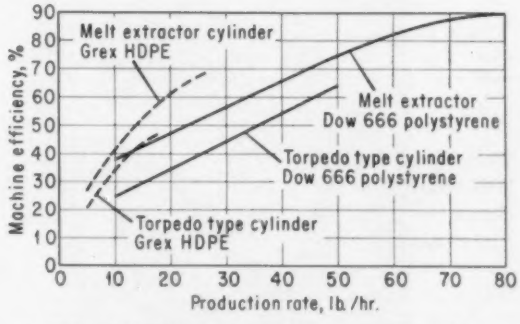


FIG. 6: Machine or thermal efficiency of melt extractor and torpedo type cylinders as a function of production rate for high-density polyethylene and polystyrene. See Eq. 2, above.

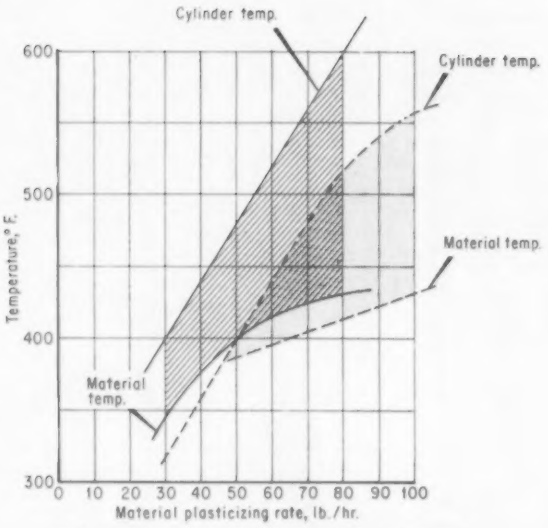


FIG. 7: Graph showing the cylinder wall temperature required to produce a given stock temperature at various plasticating rates using polystyrene (Dow 666). Dotted lines refer to melt extractor; solid to torpedo type cylinder.

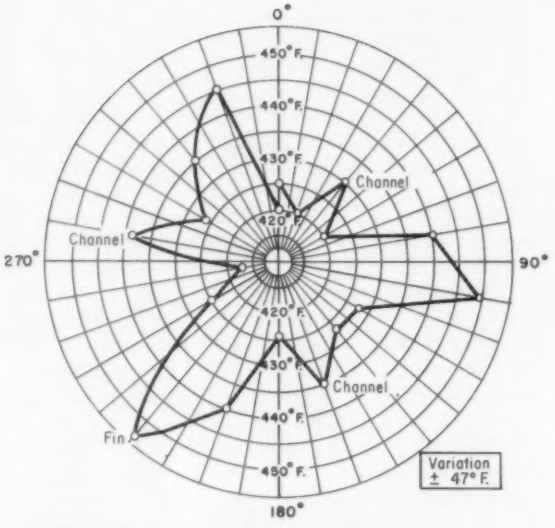


FIG. 8: Cross-section of melt issuing from a torpedo type heating cylinder showing variations in melt temperature correlating with channel and fin locations on torpedo.

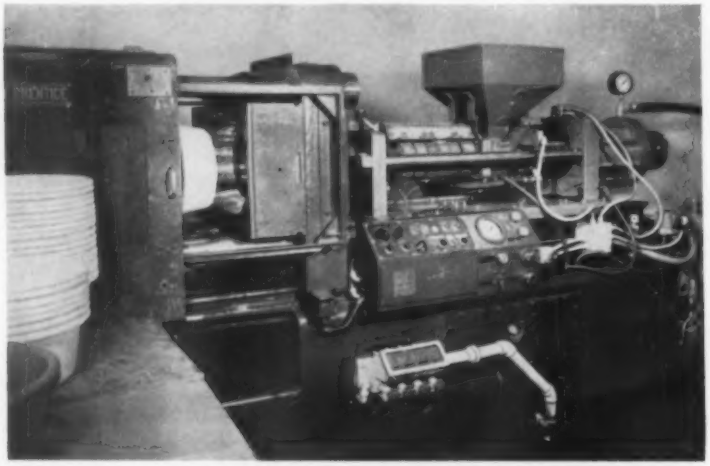


FIG. 9: Photo shows the melt extractor preplasticator mounted on a Reed-Prentice Type 300T, 12-oz. machine molding baby bath tubs weighing 31 oz. Note that the preplasticator takes up hardly any more space than the conventional hydraulic injection system.

Table I: Molding conditions for 31-oz. baby bath tub on converted 12-oz. Reed-Prentice 300T injection machine

Material	*High-density polyethylene*[a]	*Polypropylene*[b]	*High-impact polystyrene*[c]	*Low-density polyethylene*[d]
Clamp force, tons	300	300	300	300
Mold temp., °F.	130	145	130	120
Material temp., °F.	430	480	410	430
Peak injection pressure, p.s.i.	11,000	11,800	12,500	9,400
Fill rate, cu. in./sec.	18.7	18.7	18.7	18.7
Pieces/hr.	50	45	52	54
Shot wt., oz.	31	28.8	33.3	29.1

[a]Grex 60-050C. [b]Profax 6511-J. [c]Dow 475. [d]USI Petrothene 208.

melt, producing uniform temperature and viscosity throughout the mass. This is particularly true in the preplasticator under discussion where the material is further mixed in passing through the ball check valve (*10* in Fig. 1) which acts somewhat like a breaker plate. In the torpedo cylinder, laminar flow is said to predominate, and large variations in temperature are possible in the mass, as is illustrated in Fig. 8, above (2). Note how the variations coincide with the channels and supporting fins inherent in the torpedo design.

In a melt extractor preplasticator, the existence of these melt inhomogeneities is hardly possible. Importance of melt uniformity to part quality is becoming widely accepted. Non-uniformity can contribute to excessive warpage, erratic shrinkage, poor surface and appearance, excessive internal part stresses, and variations in part weight. Once thought of for only large parts, preplastication has become recognized as one of the best ways to deliver uniformly plasticated melts, and is now being considered for all molding jobs. Its popularity is evidenced by the avid interest shown in the European reciprocating screw machines, and by the sales of preplastication **(To page 198)**

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Izod Impact, Ft. Lbs./In. Notch	14.4	16.2	17.3	16.5
Tensile Strength, psi	20,300	21,300	20,100	19,300
% Elongation	1.89	1.92	1.94	1.87
Modulus of Elasticity in Tension, psi x 10^6	1.15	1.36	1.45	1.85
Flexural Strength, psi	33,150	33,600	37,800	37,000
Modulus of Elasticity in Flexure, psi x 10^6	1.08	1.18	1.44	1.20
Barcol Hardness (10 Sec. Reading) .	55	57	62	66
Initial Viscosity of Mix	1,200	2,100	3,200	5,000
Glass Mat, % by Weight . . .	40	40	33.3	33.3

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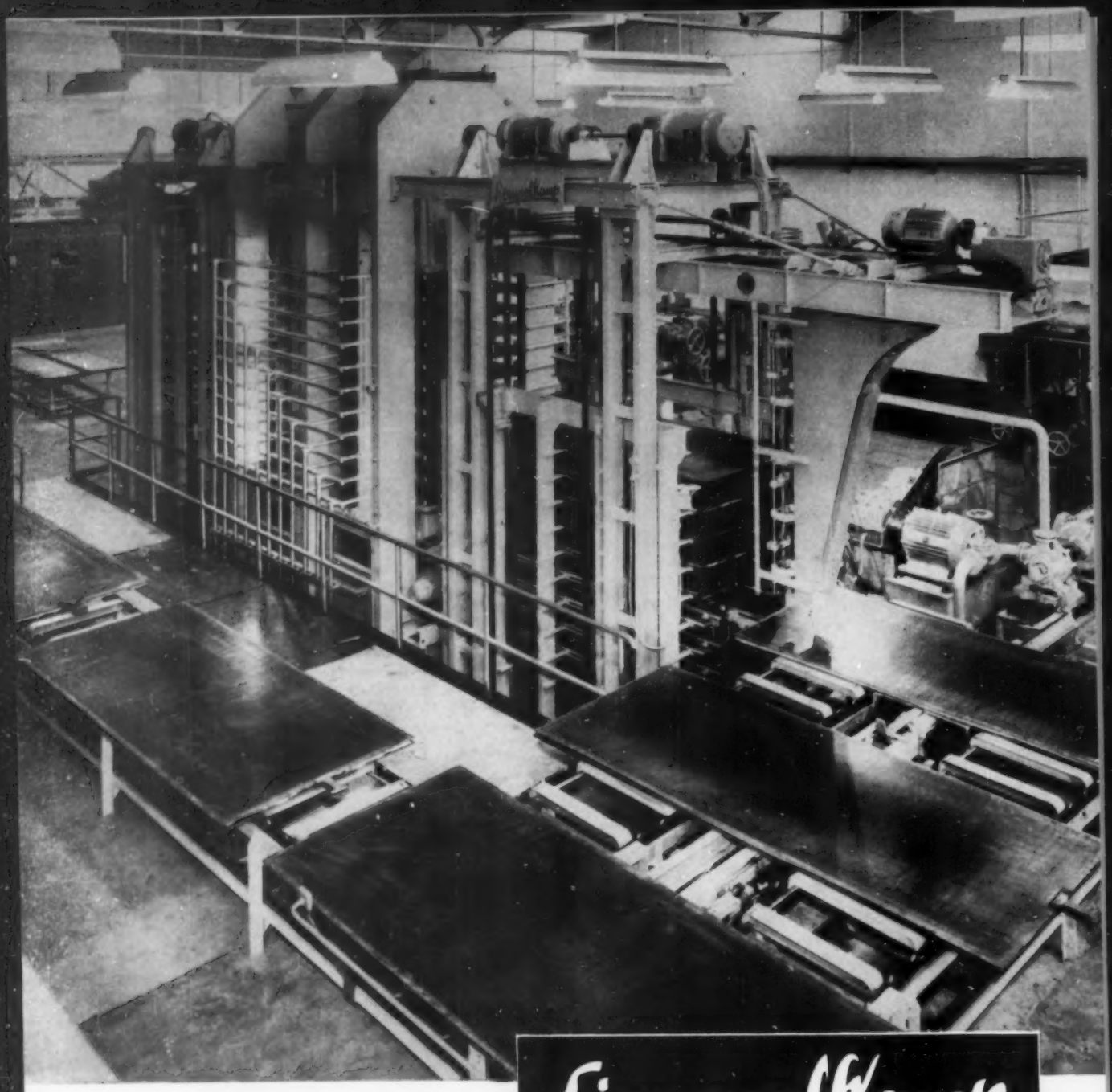

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Orientation in injection molding

How gate, cavity dimensions and other process variables can act as controlling factors in determining the net orientation in a molded piece

By R. L. Ballman* and H. L. Toor†

The flow properties of thermoplastics are determined to a large extent by the tendency of polymer molecules to orient while flowing. This effect not only causes plastic viscosity to decrease with increasing shear stress, but also leads to "frozen-in" molecular orientation when flowing plastic is solidified. In turn, frozen orientation determines the anisotropic character of plastic parts. This is of great practical importance in molding and extrusion, where flowing thermoplastic material is caused to freeze into a desired shape. Several studies of the influence of orientation on the mechanical properties of extruded sheet and of injection moldings, particularly of polystyrene, have been made. (1, 2, 3, 4, 5).[1]

This article describes how polymer flows through a cooled channel. The description is consistent with the birefringence patterns observed on simple injection molded polystyrene specimens, and the effect of several process variables on molding orientation. Although only polystyrene was used in this work, the conclusions will generally hold true for other thermoplastics, provided complicating effects such as crystallinity are not predominant.

The measurement of birefringence provides a convenient method for determining the degree of molecular orientation. When examined under plane-polarized white light, an injection molded specimen exhibits a repeating series of colored fringes, each color of which indicates a fixed amount of molecular orientation. The explanation for this phenomenon is that each ray of polarized light striking the oriented plastic is broken down into two components, one parallel to and the other perpendicular to the direction of molecular orientation. One component will travel through the plastic at a different speed from the other; the difference in speeds or retardation causes the two components to be out of phase. White light is polychromatic, and on dispersion into its component wavelengths, the retardation at any point will be just sufficient to cancel out a particular wavelength

FIG. 1: Birefringence pattern of an injection molded short shot. Orientation increases from wavefront (right) to maximum point, then decreases toward gating point (left).

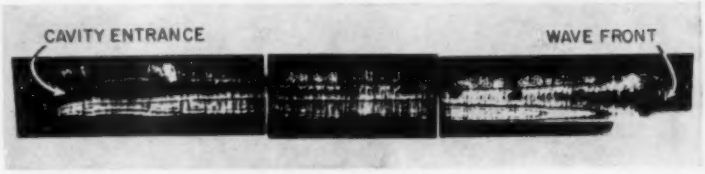

FIG. 2: Edge view of a cross-section of the piece shown in Fig. 1. Gate is at left.

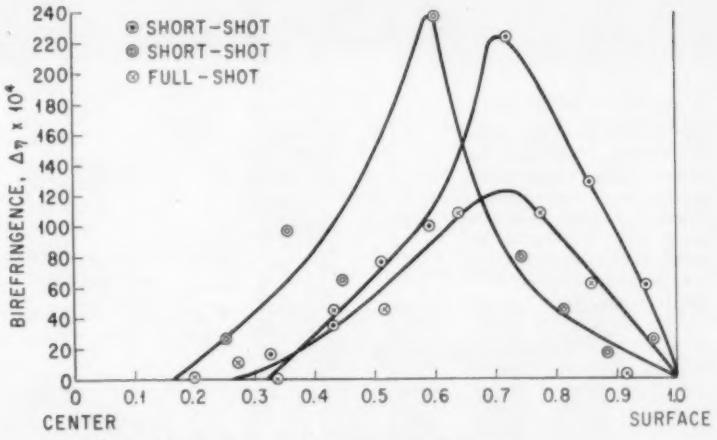

FIG. 3: Orientation as a function of the distance from the center of a molded piece expressed as a fraction of the total distance.

*Monsanto Chemical Co., Plastics Div., Springfield, Mass.
†Carnegie Institute of Technology, Pittsburgh, Pa.
[1]Numbers in parentheses refer to references at end of the article, p. 207.
This article is based on a paper presented at the 15th Annual S.P.E. Meeting, New York, N.Y., Jan. 1959.

FIG. 4: Profile of shear stress across the thickness of the molded piece in the absence of relaxation effects in an isothermal process.

FIG. 5: Profile of orientation across the thickness of the molded piece in the absence of relaxation effects in a non-isothermal process.

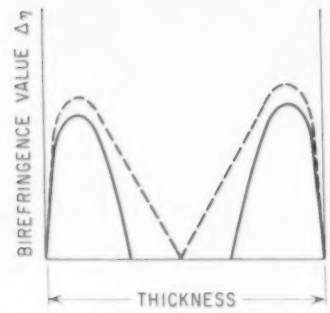

FIG. 6: Profile of net orientation across the thickness of the molded piece showing the combined effect of orientation and relaxation (solid line). Difference between solid line and dotted line is loss of orientation due to relaxation.

from the spectrum causing the eye to see the combination of the remaining colors or the complement of the cancelled color.

Orientation in injection molding

A typical birefringence pattern of an injection molded short shot is shown in Fig. 1, p. 113. This specimen is an end-gated bar 1 in. wide and 75 mils thick. It will be noted that the wavefront of this molding shows a zero order black indicating no orientation. Proceeding along the centerline of the bar to the gate, successively higher orders of orientation are encountered, each order consisting of the sequence of colors yellow-red-green. At a point near the gate, orientation is maximum and the sequence of colors then reverses indicating a negative orientation gradient over the remainder of the bar.

In a longitudinal cross section along the centerline of this mold-

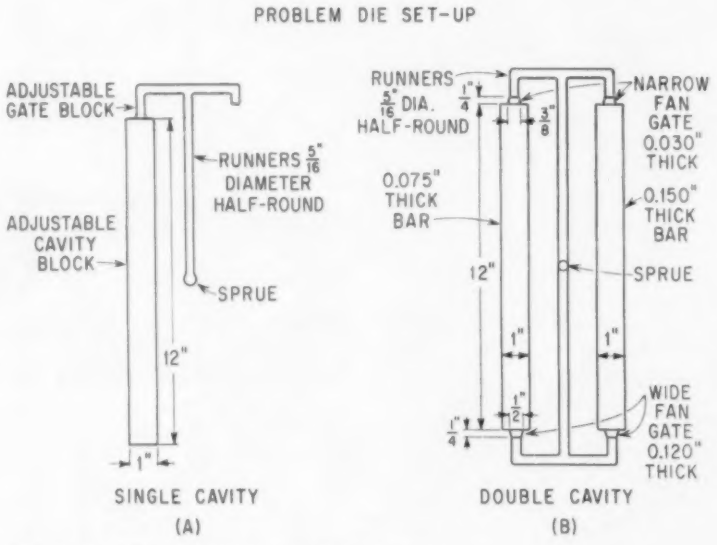

FIG. 7: Two alternate injection cavity and runner layouts used in the study.

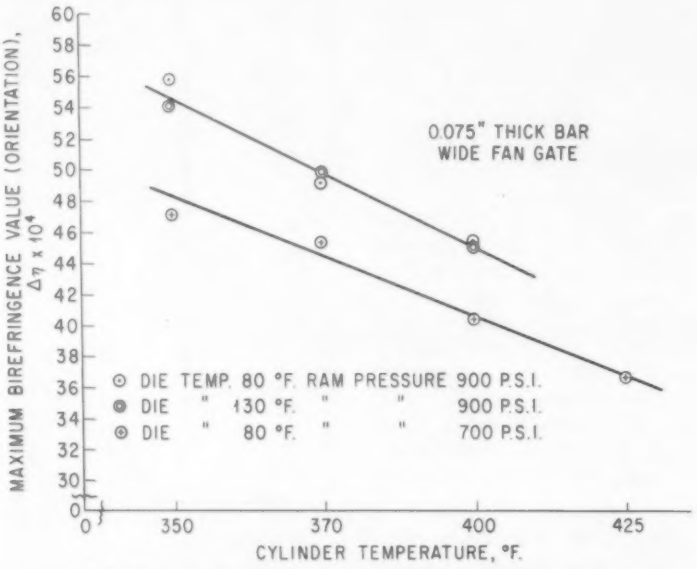

FIG. 8: Effect of cylinder temperature on orientation of polystyrene injected through wide gate.

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Elongation, ultimate	D-638		60-100%
Deformation under load	D-621		0.14%
Flexural strength	D-790		11,000-13,000 psi
Dissipation factor	D-150		
60 cycles			0.0007
10^6 cycles			0.0100
Heat distortion	D-648		
264 psi			280°F
66 psi			290°F
Flammability (in./min.)	D-635		Self-extinguishing
Clarity			Transparent
Water absorption 24 hr. immersion	D-570		0.15%

*These values have been obtained under standard ASTM and laboratory test conditions. As averages, they do not necessarily represent minimum material specifications.

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ing, the birefringence pattern is similar to that in Fig. 2, p. 113. A different birefringence pattern is the result. The zero order black at the wave front now runs completely through the centerline of the entire molding. On either side of the random central region are highly oriented layers or skins.

By abrading away successive layers from the surface of a molding and measuring the birefringence after each abrasion, the curve shown in Fig. 3, p. 113, was obtained. This plot shows how orientation varies across the thickness of a molding and describes a typical lateral cross section through the molding pictured in Fig. 2. By combining the patterns shown in these three figures, a three-dimensional concept of molecular orientation can be readily obtained on this molded sample.

Orientation and flow

How does this birefringence pattern explain the flow mechanism by which hot plastic fills the mold? Several points regarding the interpretation of the birefringence pattern should be made. First, it is assumed that birefringence in the molding is due to molecular alignment, rather than valence bond distortion or density variation. This assumption is reasonable since there is little or no change in the pattern under ordinary annealing conditions. Second, it must be remembered that the birefringence observed in a molding is the net result of two opposite effects, a) orientation induced by shearing forces during flow, and b) subsequent molecular relaxation caused by Brownian motion when the shear forces are decreased. Superimposed on both these effects is the point temperature history of the molding. These factors result in a rather complex series of interrelated events, the order and nature of which must be deduced from the evidence offered by the molding. Based on the birefringence patterns, the following mechanism for non-isothermal plastic flow can be proposed.

Consider hot polymer flowing between two wide parallel plates as in a flat bar or plaque mold. The cavity walls are maintained at a temperature below the melting point of the polymer **(To page 120)**

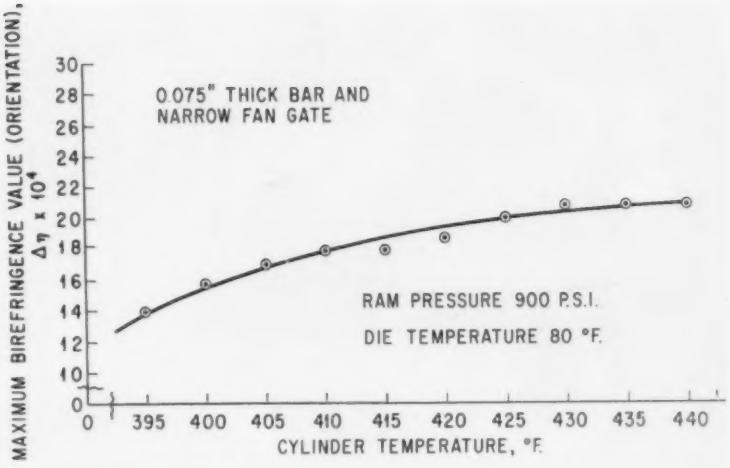
MAXIMUM BIREFRINGENCE VALUE (ORIENTATION), Δη x 10⁴
0.075" THICK BAR AND NARROW FAN GATE
RAM PRESSURE 900 P.S.I.
DIE TEMPERATURE 80 °F.
CYLINDER TEMPERATURE, °F.

FIG. 9: Effect of cylinder temperature on orientation of polystyrene injected through narrow gate.

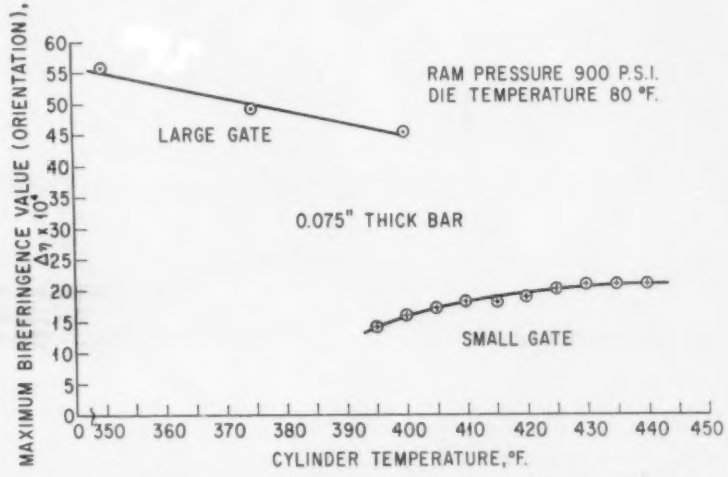

FIG. 10: Comparison of the influence of gate size on the effect of injection molding cylinder temperature on orientation of polystyrene.

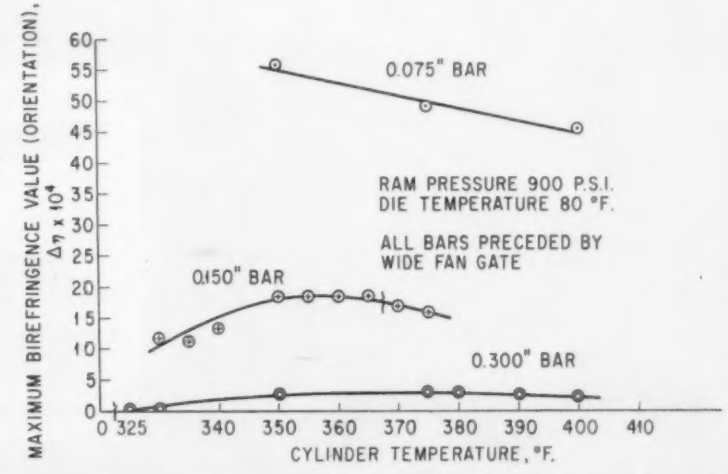

FIG. 11: Effect of cylinder temperature on orientation of injection molded polystyrene, comparing several cavity thicknesses.

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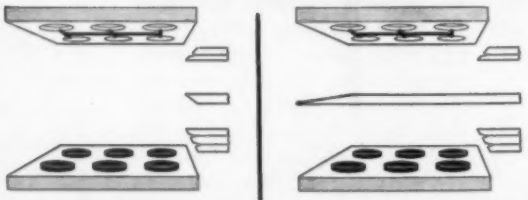

1. Press opens with molded parts positively retained in the lower die and the runner system in the upper die . . . thus accomplishing degating.

2. Separator plate moves forward under runner system.

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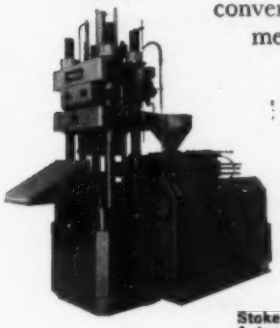
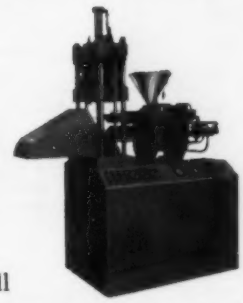


Stokes 6-ounce 703 Automatic Injection Molding Machine

*Trademark



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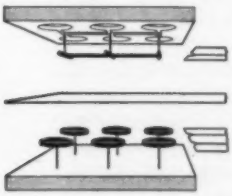
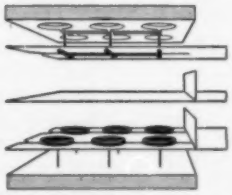
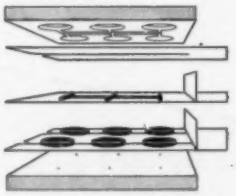


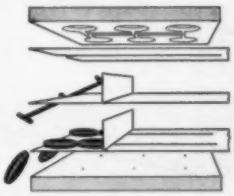
3. Knock-out pins eject the parts and runner system.



4. Separate slotted combs for parts and runners move forward into stripping position.



5. Ejector pins are retracted, stripping parts and runner system. Parts remain on lower comb and runner system falls on separator plate.



6. Wipers assure controlled removal of parts from comb and runners from separator plate into separate chutes.

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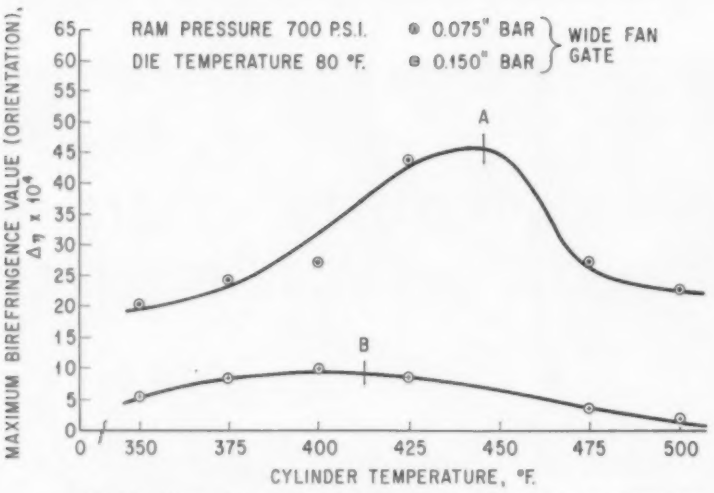

FIG. 12: Effect of injection molding cylinder temperature on orientation of polystyrene in two-cavity, four-gated mold.

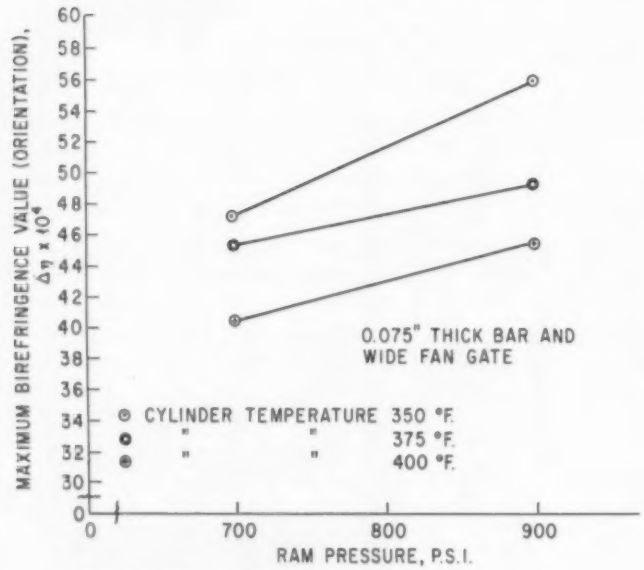
MAXIMUM BIREFRINGENCE VALUE (ORIENTATION), Δη x 10⁴
0.075" THICK BAR AND WIDE FAN GATE
CYLINDER TEMPERATURE 350 °F.
" " 375 °F.
" " 400 °F.
RAM PRESSURE, P.S.I.

FIG. 13: Effect of injection molding ram pressure on orientation of polystyrene.

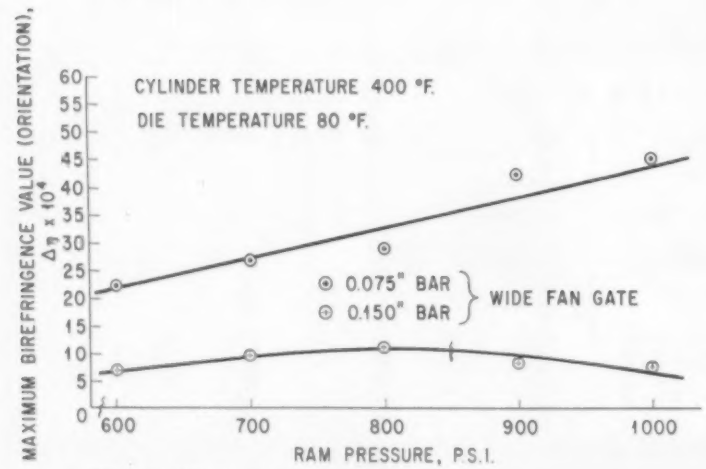

FIG. 14: Effect of injection molding ram pressure on orientation of polystyrene in two-cavity, four-gated mold.

causing that portion of the plastic in contact with the cold walls to freeze. The pressure causing flow is highest at the cavity entrance and decreases to zero at the wavefront. Since the shearing stress causing orientation at any point is directly proportional to this pressure gradient, it follows that orientation at any distance from the cavity wall will also decrease from a maximum at a point near channel entrance to zero at the wavefront. Now, as the plastic velocity at the cavity wall is zero, there must be radial flow at the wave front away from the center to the wall in order to fill the mold cavity. This results in part of the unoriented front being deposited against the wall and freezing before it can be subjected to large shearing forces. As this material was unoriented before it touched the cavity wall and froze immediately upon contact, there will be very little orientation in the surface layer of the flowing polymer. The next layer away from the frozen surface cools more slowly and has more opportunity to be sheared, after deposition between the stationary layer at the cavity wall and the melt moving through the center, therefore, causing orientation to increase with distance from the surface.

The variation of shear stress across the channel is considered next. If the cavity and the melt are at the same temperature (isothermal process), shear stress is at a maximum at the cavity walls and zero in the center, and it is a linear function of distance from the wall (Fig. 4, p. 114). In the non-isothermal case, where the cavity is cold and the melt temperature is decreasing, it is questionable how the shear stress varies across the channel, particularly in the frozen skin next to the wall. However, in the region between the frozen layers and the moving center, it is probable that the usual shear stress-distance cross section profile will be exhibited. This means that orientation will tend to vary in the same way wherever the plastic is still fluid. This is directly opposed to the wavefront deposition phenomenon described above, which causes the surface to be relatively unoriented. The result of these

competing processes is that orientation must pass through a maximum somewhere between the surface and the center as shown in Fig. 5, p. 114.

Before this description of nonisothermal plastic flow can be considered complete, several other factors must be discussed. Among the most important of these is the thickness of the frozen skin along the direction of flow.

The "frozen skin" idea is not exact, since the polymer viscosity varies *continuously* from a very large value at the cold wall to a much smaller value at the hot fluid center. However, the inner surface of the "skin" might conveniently be defined as the plane at which the viscosity has some value sufficiently great so that the velocity of the melt in this plane, caused by a shear stress of the same magnitude as occurs in the flow system, would be negligibly small.

Obviously, skin thickness is the product of skin's rate of growth and the time it has had to grow. At the wavefront, growth time is zero and the skin has not yet formed. At the channel entrance, growth time will be greatest but growth rate will be least, as new, hot material is constantly being supplied to the channel at this point. This means that the skin thickness must go through a maximum somewhere between the wavefront and the channel entrance as is shown by the area of maximum birefringence in Fig. 1.

In an actual injection molding die, plastic flow cannot proceed indefinitely. One of two events must take place. Either the polymer fills the cavity or the forces filling the mold are withdrawn. In the latter case, one of several factors might be responsible for ending flow. The injection ram might be retracted prematurely, removing the pressure on the material in the die. Or the frozen "skins" from the opposing surfaces of the flowing plastic might grow so thick that they touch and completely seal off the balance of the die cavity. When either of these events occurs, shearing forces causing orientation quickly drop to zero and the Brownian motion causes formerly oriented molecules to randomize or relax. The speed of relaxation at any point in the molding is a

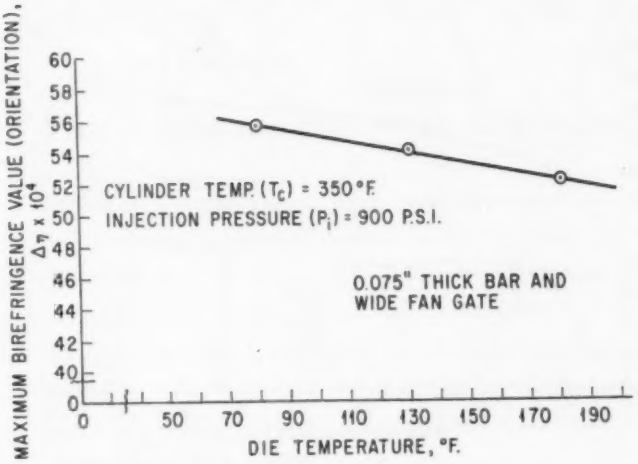

FIG. 15: Effect of injection molding die temperature on orientation of polystyrene.

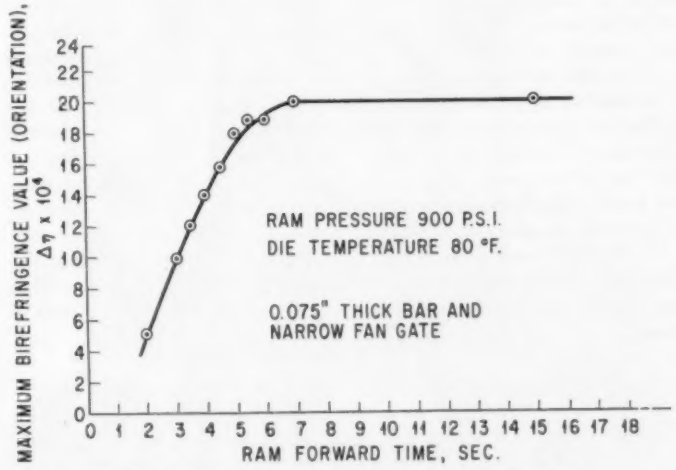

FIG. 16: Effect of injection molding ram forward time on orientation of polystyrene. Die temperature 80° F.

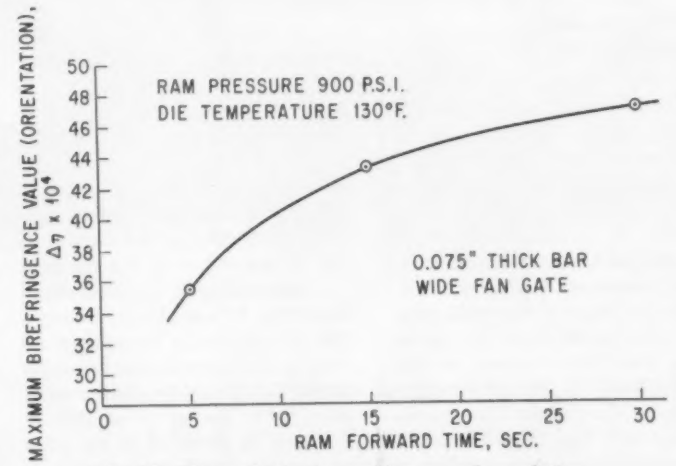

FIG. 17: Effect of injection molding ram forward time on orientation of polystyrene. Die temperature 130° F.

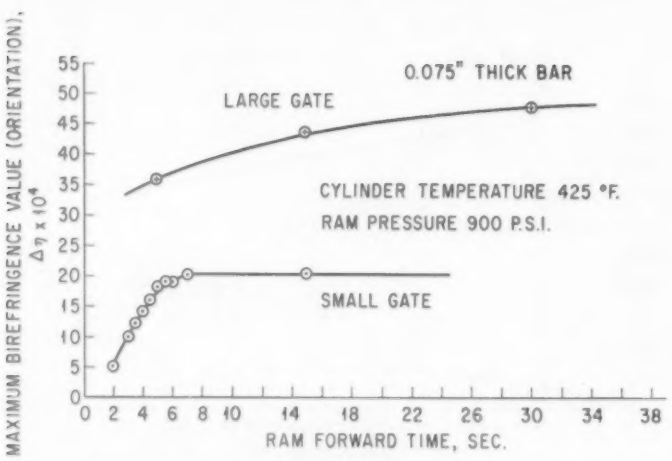

FIG. 18: Comparison of the influence of gate size on the effect of injection molding ram forward time on orientation of polystyrene.

function of temperature at that point in the plastic. Therefore, the hotter material along the centerline of the channel will relax most and completely erase all orientation. The net amount of orientation left is pictured in Fig. 6, p. 114, where the difference in birefringence between the dotted and solid lines represents the orientation lost to relaxation and reflects the temperature profile of the plastic when shear forces become zero.

Examination of the birefringence patterns of Figs. 1, 2, and 3 shows that the foregoing exposition is satisfactory at least in a qualitative sense. Using this analysis, the effect of process variables on the degree and pattern of orientation of moldings can be reasonably predicted as shown by the following results.

Molding variables and orientation

Using a special, adjustable die in a conventional 3-oz. injection molding press, the influence of molding variables on orientation was studied. In order to express the amount of orientation in a molding by a single number, it was decided to choose the birefringence maximum as shown on the widthwise view of the molding in Fig. 1. The method used for measuring the birefringence is described on p. 207. The die arrangements for the various experiments are shown in Fig. 7A and B, p. 114.

Considerable care was taken to achieve equilibrium molding conditions in all the experiments—at least two hours being required per condition. Equilibrium conditions for short shots were checked by measuring the length (X_f) of the shot. When three successive averages of 10 shots differed by no more than 0.1 cm., conditions were considered to be at equilibrium. For full shots, birefringence observations of each shot plus the data on the short shots provided satisfactory equilibrium checks.

Cylinder temperature

Noting that the observed orientation (birefringence) is the initial orientation of the molding and relaxation after the shear stress has dropped to zero, one would predict that orientation decreases as the molding temperature increases, reasoning that with all else equal, increasing the stock temperature increases relaxation thus decreasing the net amount of orientation. The results in Fig. 8, p. 114, bear this out at two different ram pressures, and die temperatures. Data in Fig. 9, p. 117, however, show just the opposite effect with *increasing* width cylinder temperature. The answer to this anomaly lies in the die layout that was used. The first set of data (Fig. 8) was obtained using a 120-mil gate and a 75-mil bar, all other molding conditions being the same. Using a large gate, sealing occurred *in the bar* rather than in the gate. It occurred at the point where the birefringence was a maximum. Relaxation in the bar was minimized, resulting in a higher overall level of orientation (Fig. 10, p. 117). Increasing cylinder temperature increased relaxation after the ram was withdrawn giving the curve shown.

In the second case, sealing occurred early, in the gate, allowing the entire bar to relax considerably after sealing, resulting in a generally lower level of orientation. However, the time of gate sealing will depend directly on the stock temperature. Higher temperature allows flow in the cavity to continue longer before sealing occurs. During flow time, the skin on the bar is increasing in thickness so that the longer the gate sealing is delayed, the higher the birefringence. Of course, this is partially cancelled out by subsequent relaxation after sealing so that Δ_a vs. T_c curve is not steep.

The effect of cylinder temperature on orientation was investigated for several cavity thicknesses as shown in Fig. 11, p. 117. The 75-mil bar preceded by a 120-mil gate results in cavity sealing and the relationship discussed above. When this larger gate was followed by a thicker cavity, i.e., 150 mils and 300 mils, sealing also took place in the gate resulting in the increasing orientation-temperature relationship discussed above. It will be noted that after the cavity is filled (to the right of *A* and *B* in Fig. 12, p. 120), orientation decreases with temperature. In this case, gate sealing did not occur until late in the molding cycle after flow had stopped and some relaxation had already taken place in the cavity. As the amount of relaxation increases with cylinder temperature, orientation begins to fall off with increasing cylinder temperature.

The application of these same principles can be shown also in the more complicated four-gated, two-cavity mold (see Figs. 7 and 12). As is to be expected, the 75-mil bar is considerably more oriented than the 150-mil bar molded at the same time. However, there is a difference between these curves and the single cavity results discussed above. In this case orientation increases with temperature on *both* the 75-mil and 150-mil bars preceded by the 120-mil gate. The 75-mil bar behaves differently

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here because the flow in this cavity is variously influenced by simultaneous parallel flow in the 150-mil bar. A study of the original data revealed that at 400° F. and 800 p.s.i. ram pressure, flow in the 75-mil bar has practically stopped within 3 sec., whereas significant flow continued for at least 15 sec. in the 150-mil bar. It seems reasonable that plastic flow in the thicker bar continues longer than in the thinner bar over the entire temperature range covered in Fig. 12 up to 425° F., where flow is prematurely halted by the end of the cavity. Of particular interest is the large increase in 75-mil bar orientation at this temperature. A likely explanation is that the 150-mil bar filled out before the thinner bar had sealed off, and resulted in a sudden diversion of all the press pumping capacity to the 75-mil bar (or more precisely, an increase of pressure at the bar inlet). The increase of 75-mil bar orientation with temperature up to 425° F. probably stems from this same sequence of events in a modified form. That is, the balance of pumping capacity between the two bars varies with time in such a way that increasing cylinder temperature tends to shift the balance to a thinner bar. This effect more than compensates for increased relaxation at higher temperatures.

Ram pressure

As would be expected, orientation increases with ram pressure (Fig. 13, p. 120 and Fig. 14, p. 120) except in those cases where fillout occurs (at 900 and 1000 p.s.i. on the 150-mil bar in Fig. 14). Then the effect of ram pressure is less obvious and depends on other factors. For example, compare the orientation of the 150-mil bar at 900 and 800 p.s.i. in Fig. 14. The lower pressure bar is short and has higher orientation than the other bar which is full. The most probable reason for this is that filling the 900 p.s.i. bar allowed the gate to seal more rapidly, thus allowing more relaxation than was possible on the short shot. The speed with which the gate can seal decreases as the velocity of the fluid passing through the gate increases. (It has been thought that there might exist a critical velocity beyond which the gate might never seal.) In any case when the plastic wave front encounters the end of the cavity, the velocity in the gate suddenly drops to nearly zero, at which time the rate of skin growth in the gate accelerates enormously, rapidly seals the gate, and closes off the cavity from further pressure transfer. Shearing forces in the cavity disappear and permit relaxation of the hot plastic.

Additional increase in ram pressure after the minimum molding pressure has been reached can effect orientation of the molding in both of the ways discussed above. That is, an increase in ram pressure increases shear stress which in turn causes higher orientation. In some cases, where the die rather than the press is controlling, (6), additional pressure causes the cavity to fill more rapidly, allows the gate to seal sooner when the stock in the cavity is hotter, thus permitting more relaxation. The net result of these two compensating phenomena depends upon the particular molding conditions used. In the case illustrated in Fig. 14, initial stress and relaxation effects must be nearly equal as orientation in this region appears to be essentially independent of ram pressure.

Die temperature

Effect of die temperature on orientation is shown for the single-cavity, Fig. 15, p. 121. **(To page 205)**

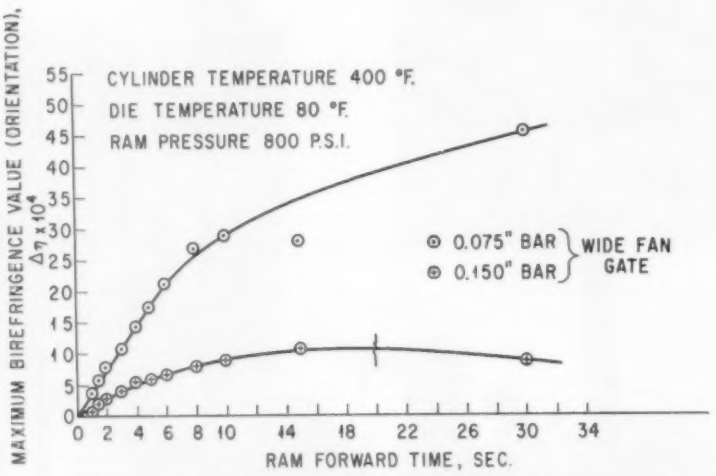
MAXIMUM BIREFRINGENCE VALUE (ORIENTATION), Δη x 10⁴
CYLINDER TEMPERATURE 400 °F.
DIE TEMPERATURE 80 °F.
RAM PRESSURE 800 P.S.I.
⊙ 0.075" BAR
⊕ 0.150" BAR
WIDE FAN GATE
0 2 4 6 8 10 14 18 22 26 30 34
RAM FORWARD TIME, SEC.

FIG. 19: Effect of injection molding ram forward time on orientation of polystyrene in two-cavity, four-gated mold.

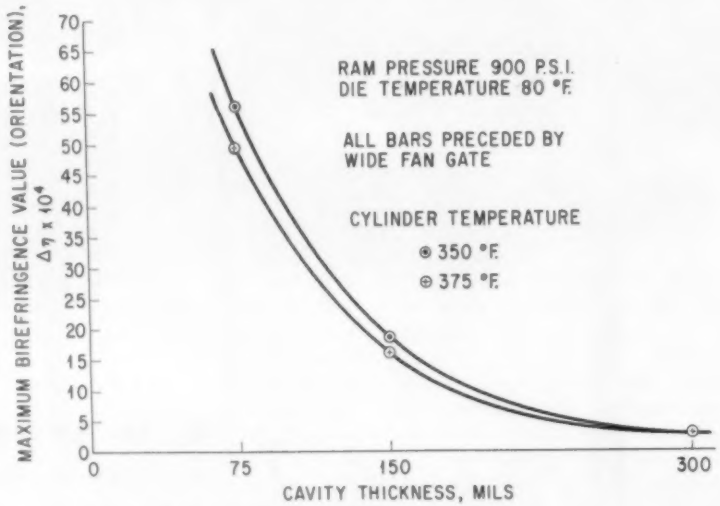
MAXIMUM BIREFRINGENCE VALUE (ORIENTATION), Δη x 10⁴
RAM PRESSURE 900 P.S.I.
DIE TEMPERATURE 80 °F.
ALL BARS PRECEDED BY WIDE FAN GATE
CYLINDER TEMPERATURE
⊙ 350 °F.
⊕ 375 °F.
0 75 150 300
CAVITY THICKNESS, MILS

FIG. 20: Effect of cavity thickness on orientation of injection molded polystyrene.

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MARLEX PLASTICS

How to extrude plastisols

Pump feeding of plastisols overcomes surging and low rates with fast gel formulations

By C. H. Brower* and B. H. Maddock*

Extrusion coating of cloth, paper, and other substrates with plastisols can have several important advantages over conventional spread coating methods: 1) Wider formulation latitudes are possible with plastisol extrusion coating because plastisol rheology is not a limiting factor with this process as it is with conventional coating methods; 2) Total energy requirements (power plus heat) for extrusion of plastisols are considerably less than that required for oven fusion methods.

In view of these very real advantages, the fact that plastisol extrusion is not widely used suggests that problems exist.

A plastisol, basically, is a dispersion of vinyl resin in plasticizer. Heated to the fusion temperature (usually about 350° F.) the dispersion rapidly becomes a homogenous liquid; allowed to cool, it solidifies. But this is only part of the story. In practice, as temperature goes up, the particles of vinyl absorb plasticizer, and form a gel before reaching fusion temperature. The rate of gel formation depends upon the system temperature and formulation. When the plastisol is heated rapidly, the gel forms and disappears quicker than when heated slowly. Monomeric plasticizers, such as dioctyl phthalate (DOP), have faster gel rates than the polymeric types.

Because of this complex behavior pattern, a plastisol performs very differently from solid vinyl compounds as it moves through the extruder. Surging and low extrusion rates often occur due to gel formation.

While these disadvantages appeared to outweigh the advantages of plastisol extrusion, the latter were too important to be ignored and a study of the process was undertaken.

*Development Department, Union Carbide Plastics Co., Div. of Union Carbide Corp., Bound Brook, N. J.

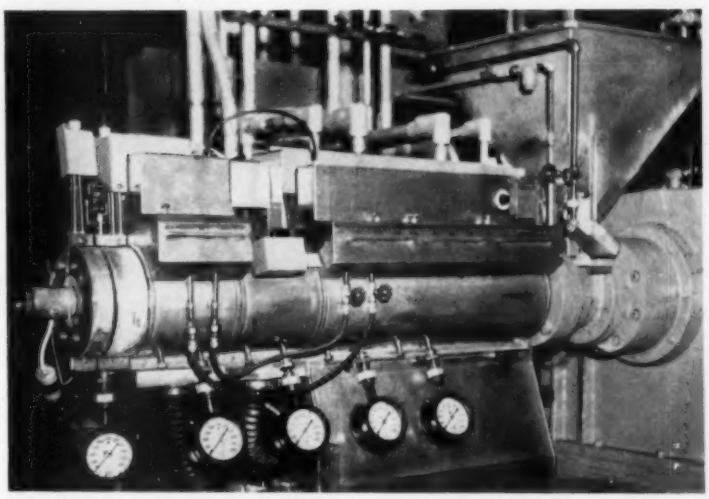


FIG. 1: Extrusion test equipment showing placement of extrusion pressure gages on the barrel.

Table I: Plastisol formulations that were studied[a]

Plastisol A—Fast-gelling	
Bakelite vinyl resin QYNV	100
Flexol plasticizer DOP	50
Mark LL (Argus Chemical Co.)	3
Bakelite Epoxy Resin ERL-2774	2
Plastisol B—Slow-gelling	
Bakelite vinyl resin QYNV	100
Flexol plasticizer DOP	25
Paraplex G-50 (Rohm & Haas Co.)	25
Mark LL	3
Bakelite Epoxy Resin ERL-2774	2

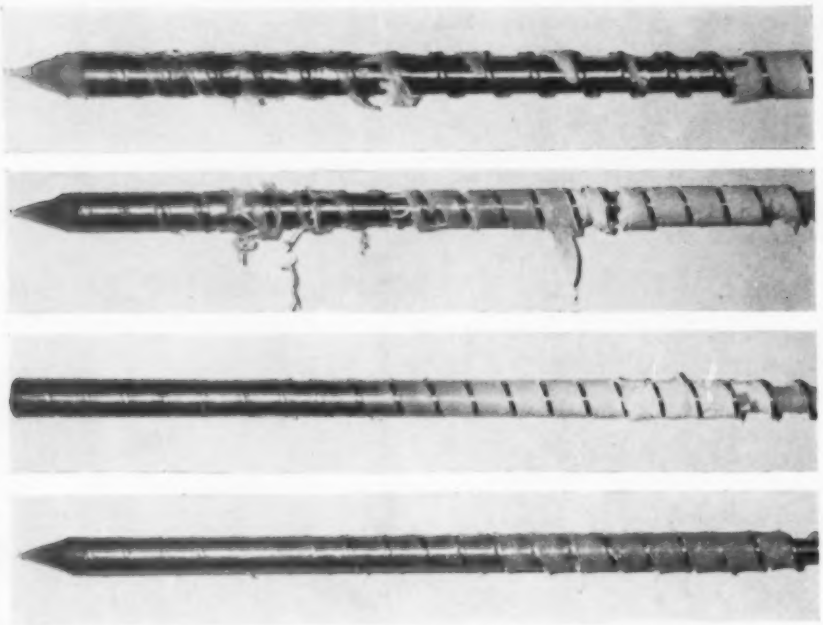
[a]The plastisols were prepared by blending the ingredients with a Hobart mixer. The resin was first dispersed in 90% of the plasticizer. The remaining plasticizer and stabilizers were added after the initial mix became smooth and fluid.

Test procedures

Extrusion tests were made on an extruder with a screw diameter of 2.5 in. and a L/D ratio of 22:1. An ordinary metering type screw with a channel depth of 0.094 in. in a 4-turn metering section, and a compression ratio of 4.5:1 was used for the tests. Screw speed was held at 40 r.p.m. during all runs. The screw was removed after each test for visual examination of the material in the channel. The extruder was also equipped with gages to measure pressures along the barrel. For this equipment, see Fig. 1, above.

Two types of plastisols were studied—a fast-gelling type formulated with DOP plasticizer (Plastisol A), and a slow-gelling type (Plastisol B) in which part of the monomeric plasticizer was replaced with a polymeric component (see Table I, at left). Quantities of both types were also processed into pellet form for comparative tests. In Fig. 2, p. 128, the typical performance of these compounds (including Plastisol A at two pressures) is given along with photos of the screw after each run.

Under all test conditions, the extrusion of Plastisol A was char-



PLASTISOL A
Pressure: 350 p.s.i.
Rate: 17.6 lb./hr.

PLASTISOL A
Pressure: 3500 p.s.i.
Rate: surging badly

PLASTISOL B
Pressure: 4300 p.s.i.
Rate: 55.4 lb./hr.

PLASTISOL B
Pellets; pressure: 4000 p.s.i.
Rate: 54.2 lb./hr.

FIG. 2: Extruder screws with solidified material in the channels illustrating the results obtained with the two different formulations using liquid and compounded pellet feeds.

acterized by low, unstable rates. Examination of the screw in each case showed completely filled rear flights and partly filled forward flights. The material in the rear flights was plastisol that had reached the gel stage and formed a block that resisted further forward flow of the plastisol through the extruder.

Quite different results were obtained with Plastisol B, and with pellets prepared from both types of plastisols. Extrusion rates were high and uniform. Screws when removed for examination were completely filled.

To further develop an understanding of the basic differences in the performance of both fast- and slow-gelling plastisols, the relative rates of gelation were measured using a Brabender Plastograph. In this equipment, the energy consumed, in terms of the torque developed in mixing a material, is plotted vs. time. The time needed to reach maximum torque is a measure of gel rate. Tests were performed by placing weighed amounts of plastisol in the cup of the Plastograph. The mixing chamber temperature was controlled at 375° F.

Gel rate curves for Plastisol A and B are shown in Fig. 3, left. The two curves provide the solution to the difference in extru-

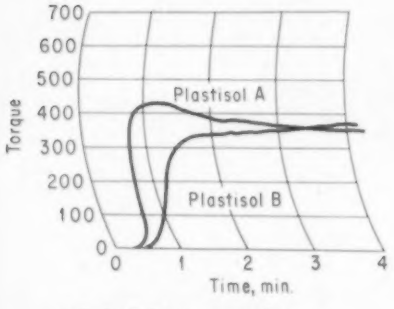


FIG. 3: Gel rate curves for a fast (Plastisol A) and slow (Plastisol B) gelling formulation. Increase in torque is indicative of gelation.

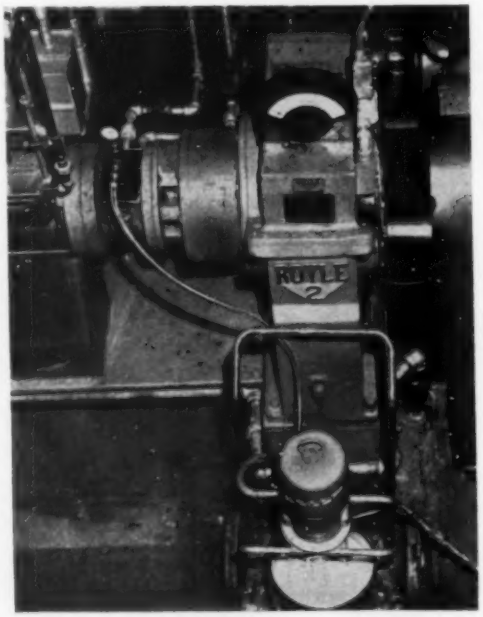
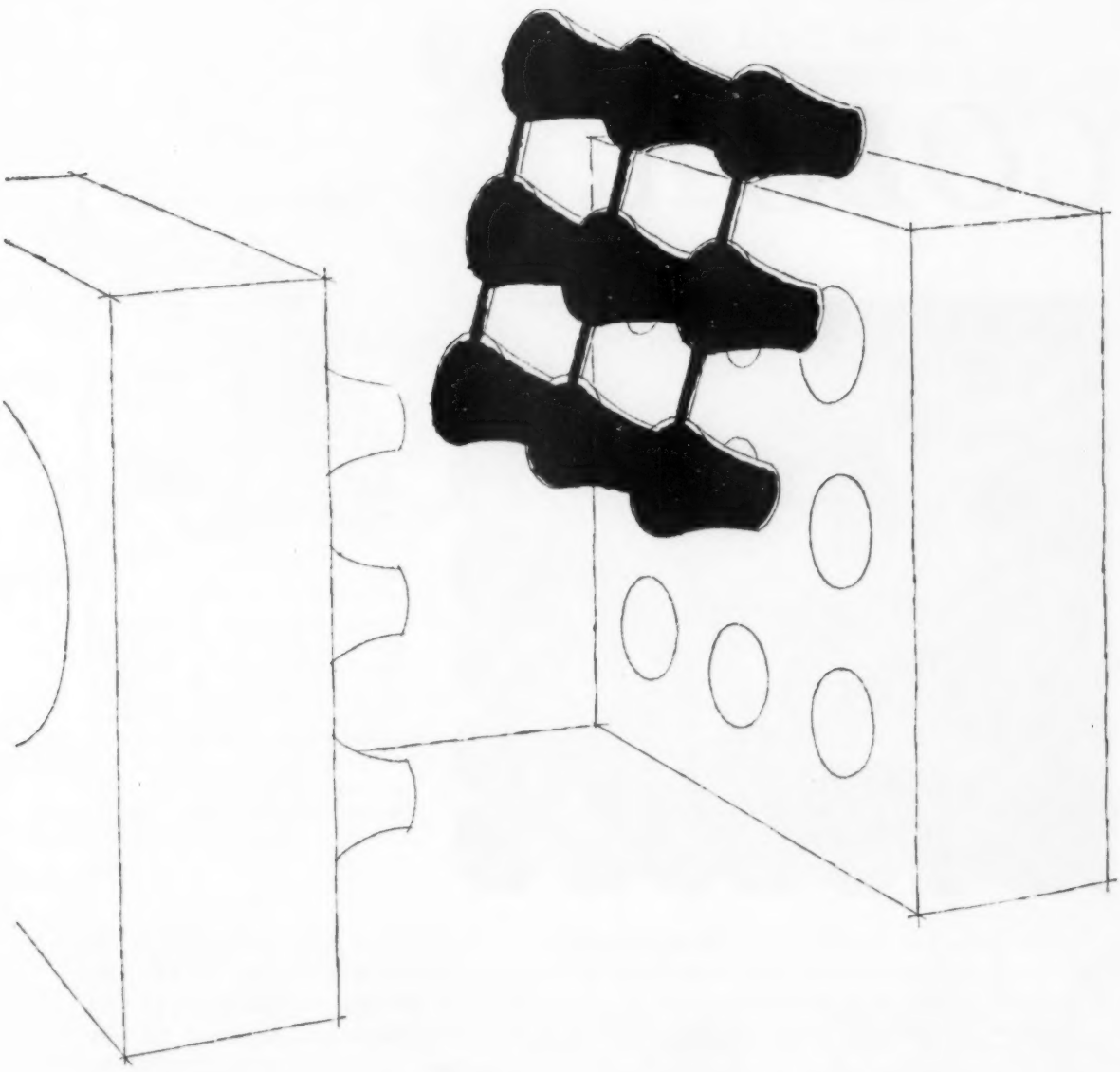


FIG. 4: Feed throat of the experimental extruder showing the pump feeding system (lower center) and modified feed port.



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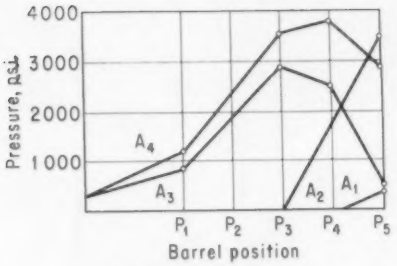

FIG. 5: Profiles of pressures along the extruder barrel. Curves A_1 and A_3 were run maintaining a low pressure at P_5 with hopper and pump feeds respectively. Curves A_2 and A_4 were run with a high pressure at P_5; hopper and pump feeds respectively. All runs with Plastisol A.

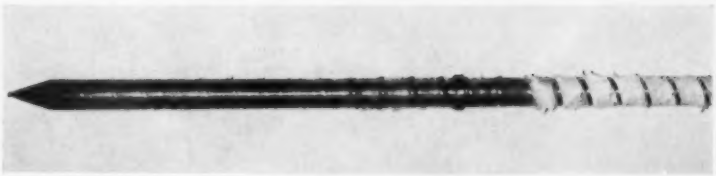

FIG. 6: Screw is shown immediately after a pump feed run on Plastisol A. Screw speed was 40 r.p.m.; pressure, 450 p.s.i.; extrusion rate, 81 lb./hr.

sion behavior. Plastisol A gelled almost instantly relative to Plastisol B.

The gel rate curves correlate with the behavior of these plastisols in the extruder. As it proceeds along the heated barrel, Plastisol A absorbs enough heat to begin gelling. Almost at once a slug of very stiff gel blocks the screw channel. As the block forms in the rear of the extruder, action may become erratic since the screw can transmit little forward force through the liquid phase of the plastisol to the gel phase. Instead, the liquid flows around the threads of the screw. The net result is simply that a screw is a very inefficient device for transmitting pressure through a low-viscosity liquid.

Plastisol B extrudes smoothly because of its relatively slow gel rate. The gel slowly stiffens as it passes down the extruder barrel. At any point, the stiffness of the gel is only slightly greater than that of the material just back of that point. Thus the screw can transmit, smoothly and continuously, pressure in a forward direction. Extrusion rate, therefore, is high and uniform.

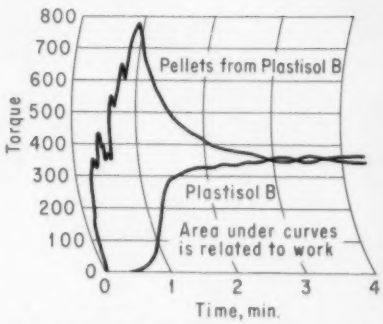

FIG. 7: Graph compares the energy required to extrude pellets and plastisol feeds prepared according to Formulation B, Table I, p. 127.

Pump feed for fast-gel plastisols

To extrude fast-gelling types of plastisols, a positive means of applying pressure on the liquid at the rear end of the screw was needed. Pump-feeding was found to be the best method. The extruder hopper, through which both plastisol and pellets had been fed, was removed and replaced with a fitting connected **(To page 208)**

Table II: Summary of extrusion test run conditions

	Hopper-fed					*Pump-fed*	
	Plastisol feed			*Pellet feed*		*plastisol*	
Formulation	**A**	**A**	**B**	**A**	**B**	**A**	**B**
Extruder temp., °C[a]							
Zone No. 1[b]	40	100	110	175	220	200	200
Zone No. 2	115	100	115	175	200	200	200
Zone No. 3	175	170	160	175	175	200	200
Zone No. 4	175	145	145	175	145	150	150
Zone No. 5	175	145	145	175	145	150	150
Head and die temp., °C.	190	190	190	190	190	175	175
Screw cooling, rear only							
Water temp. in, °C.	18	19	20	18	18	—	—
Water temp. out, °C.	30	30	32	35	35	—	—
Rate, gal./min.	0.35	0.3	0.3	0.3	0.3	—	—
Screw speed, r.p.m.	40	40	40	40	40	40	40
Delivery rate, lb./hr.	17.6	[c]	55.4	69.1	54.2	81	65.6
Stock temp., °C.	199	199	206	204	199	200	201
Pressure at die, p.s.i.	350	3500[c]	4300	500	4000	450	2925
Mechanical work hp.-hr./lb.	0.0139	[c]	0.0443	0.051	0.0922	0.0286	0.0366

[a]Indicated on controller. [b]Rear. [c]Surging badly; delivery rate and work not calculated.

Flying scale model of a P-40 fighter plane was molded by L. M. Cox Mfg. Co., Inc., Santa Ana, California.

TMD-2121, flame resistant modification of TMD-2100, was specified for the motor housing of the Shetland Floor Washing Vacuum Cleaner. Molded by Produx Co., Inc., Shrewsbury, Mass. for The Shetland Home Care Institute, Shetland Industrial Park, Salem, Mass.

Hot-and-cold picnic jug thermoformed by Columbian Enameling and Stamping Co., Terre Haute, Indiana, from sheet extruded by Kal Plastics Inc., Beaverton, Michigan.

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Property Highlights of BAKELITE TMD-2100

All properties determined by ASTM methods on ⅛-inch specimens cut from injection molded plaques.

	Typical Property Values		
	—40°C	23°C	60°C
Tensile strength, lb./sq. in.	4800	3200	2100
Elongation in Tension, %	22	44	58
Mod. Elast. in Tens., lb./sq. in.	302,000	245,000	200,000
Flexural Yield, lb./sq. in.	13,250	6,300	3,700
Mod. Elast. in Flex., lb./sq. in	360,000	290,000	195,000
Izod Impact Str. ft-lb./in. notch	1.4	6.3	9.0

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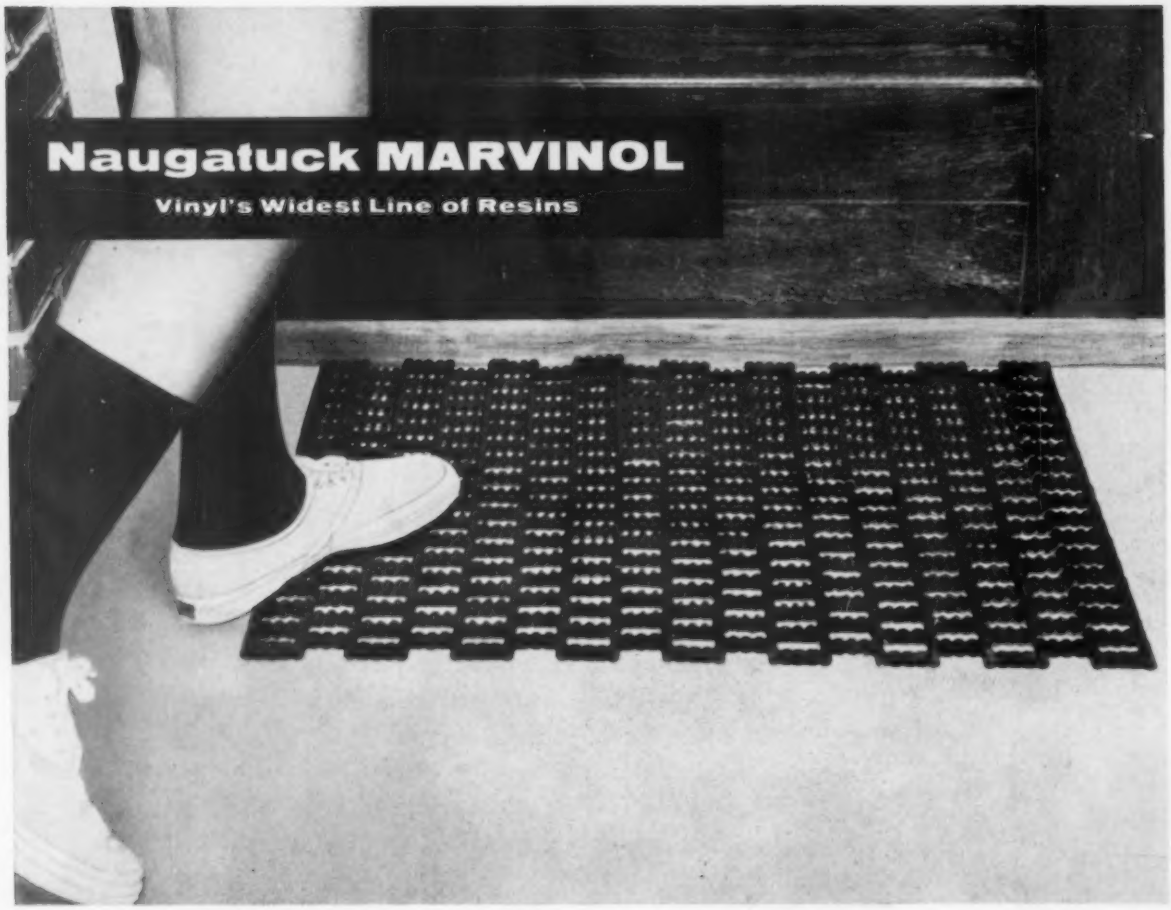

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The doormats of MARVINOL are attractive, economical to produce, almost indestructible.

Whether used for commercial buildings or private homes, these mats withstand the toughest abrasion that scraping feet can give. Severe outdoor conditions can't damage these mats. MARVINOL won't rust, rot, be corroded by ozone or other chemicals.

*Protected by Pat. No. 2,919,458

What's more, these mats stay flexible and non-brittle in sub-zero weather, retain their strength in summer heat. The easy-to-extrude MARVINOL resins also have a built-in resiliency that lasts the life of the product.

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PLASTICS* TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

The ABMA reinforced plastics ablation program

By W. R. Lucas† and J. E. Kingsbury†

The place of reinforced plastics for applications in hyperthermal environments is established. It has been found, however, that no single system is applicable generally inasmuch as ablation rate is controlled by the environment as well as by the materials and manufacturing techniques. Further, ablation rate is not the only important property of nose cone insulation material. Surface conditions during re-entry, mechanical and electrical properties of the material, and manufacturing feasibility are important considerations. Since the efficiency of reinforced plastic ablation systems increases with increasing heating rate, there is no practical upper limit to the thermal environment for which these plastics might be applicable.

The study of materials for hyperthermal applications began at Redstone Arsenal with the establishment of the missile activity at this location. The original impetus was the need for a domestic graphite equivalent to the German grade used for jet vanes on the V-2 missile. A satisfactory grade was discovered; however, the quality control of this graphite for the jet vane application was so poor that less than 25% of the average lot was acceptable.

In an attempt during 1953-1954 to replace graphite as the jet vane material, a vane made from a commercial fibrous-glass-reinforced melamine resin was tested in the Redstone rocket motor. In this test, the surface of the jet vane eroded, and there was delamination in areas where the layers of the laminate were oriented parallel to the surface (Fig. 1, right). However, at a distance of ¼ in. or less beneath the surface, the material appeared to be entirely unaffected, and thermocouples at this location gave no evidence of heating. A cross section of that material (Fig. 2, p. 136), made at the time of the test, demonstrates what we now refer to as the ablation front.

That a material designed for use at temperatures slightly above ambient could withstand the rocket exhaust (gas temperature 4500° F.) for several seconds with such limited damage was a surprise to those conducting the test. Although this material was never utilized as the jet vane material for the Redstone missile, this experience provided the starting point for the study of ablating types of nose cone insulation.

*Reg. U. S. Pat. Off.
†Army Ballistic Missile Agency, Redstone Arsenal, Ala.

Protective techniques

At the outset of the Jupiter program, consideration of a wide number of nose cone protection techniques was already under way. Among these techniques were: 1) transpiration cooling, 2) ceramic insulators, 3) heat sink, and 4) ablation.

Transpiration cooling. This technique involves the utilization of the heat of evaporation of a material which is forced through porous walls to the surface of the nose cone. Although the technique works, it was not considered suitable for IRBM nose cone protection since its implementation would require a complicated piping system.

Ceramic insulators. The use of a ceramic skin results in a very

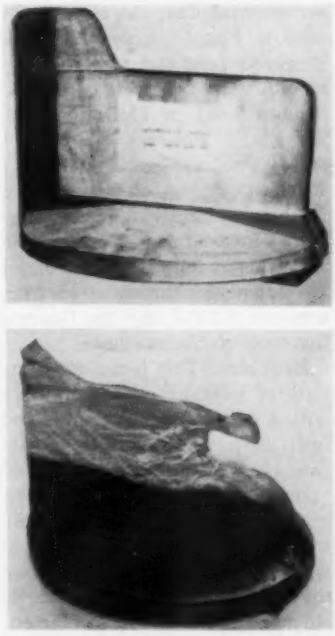
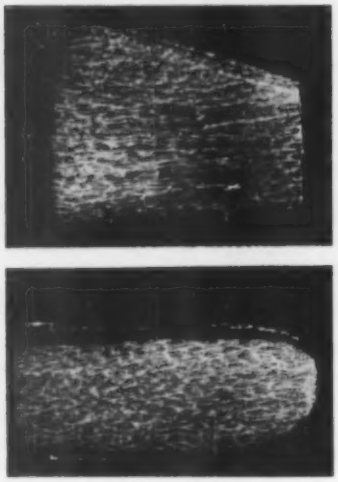


FIG. 1: Reinforced plastics jet vane before and after test.

FIG. 2: Cross-sections of reinforced plastic jet vane after test was completed.



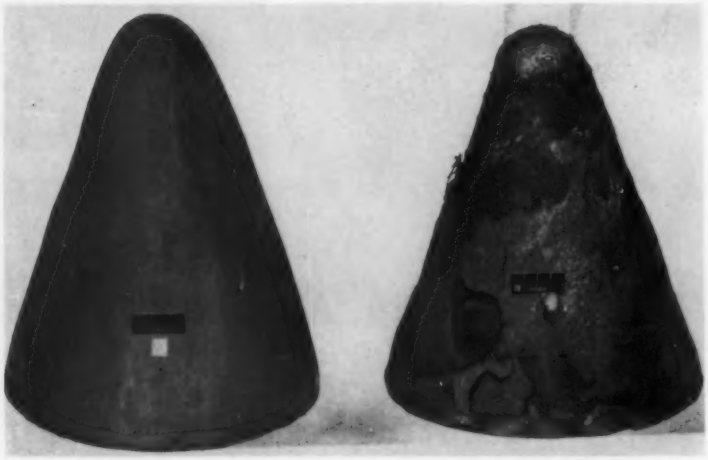


FIG. 3: Unfired ceramic nose cone before and after test. Test conditions: stagnation heat flux—330 B.t.u./ft.^{2}-sec.; stagnation gas temperature—2700° K., and gas velocity—6700 FPS.

high surface temperature with a high thermal gradient and keeps the heat flow into the nose low. This approach is very promising from a weight standpoint. From a practical view, however, ceramic skins suffer from a lack of resistance to thermal shock; that is, the high thermal gradient across the material results in the mechanical failure of the insulation. Figure 3, above, demonstrates what usually occurred in early tests with ceramic nose cones. Continued work, however, has provided improved ceramics, as demonstrated by the cone in Fig. 4, right, which was prepared from an unfired mixture. A very promising ceramic is demonstrated in Fig. 5, p. 137. This is a slip-cast, amorphous silica cone which has been designed to reduce thermal shock. It ablates slightly under a stagnation heat flux of 330 B.t.u./ft.^{2}-sec. This material is still under development through contract between ABMA and the Georgia Institute of Technology.

Heat sink. This technique consists of covering the nose cone with a material of high mass and heat capacity so that this mass can absorb the heat generated upon re-entry, thus maintaining a low temperature within the cone. This is a relatively simple technique, but its use increases the weight of the nose cone markedly and is not the most efficient system for IRBM nose cones.

Ablation. In this scheme, heat is absorbed through the melting, vaporizing, and decomposing of the insulating material—actually, through a combination of these processes since they are occurring simultaneously. Material is removed continuously from the surface in this manner. If the ablating material is a reinforced plastic, the reinforcement melts and the resin decomposes, leaving a residue of carbon. Carbon can be vaporized if the surface temperature is high enough. The carbon can react with other decomposition products, or it can simply provide a hot reaction zone for the pyrolysis of the resin. Phase changes and distillation of certain constituents of the reinforcing material are also involved in the heat absorption of an ablating surface. At any rate, all the reactions occur in a relatively thin layer on the surface.

The thermal protection applied to a nose cone serves two basic purposes: it prevents the destruction of the re-entry body and it serves as insulation to keep the interior of the cone at a sufficiently low temperature. Assuming a reasonable IRBM trajectory and a given nose cone configuration, the amounts of various types of materials required to maintain a given inner surface temperature are shown in Fig. 6, p. 137. This

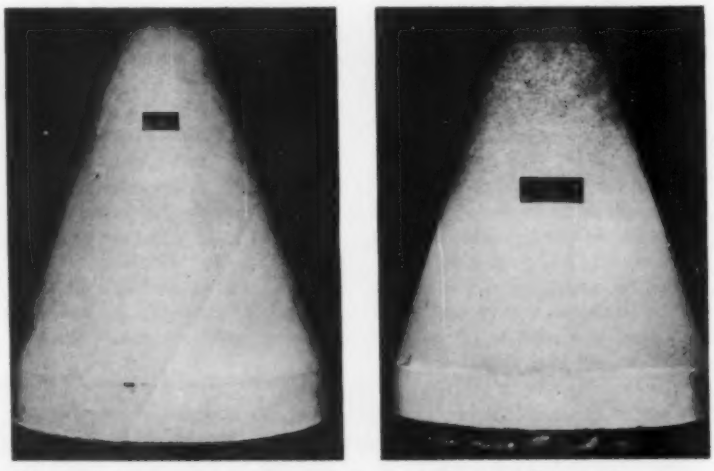


FIG. 4: Unfired ceramic nose cone before and after test. Test conditions: stagnation heat flux—330 B.t.u./ft.^{2}-sec.; stagnation gas temperature—2700° K.; and gas velocity—6700 FPS. Sections of linear scale, applied to indicate size of cone, are of arbitrary length.

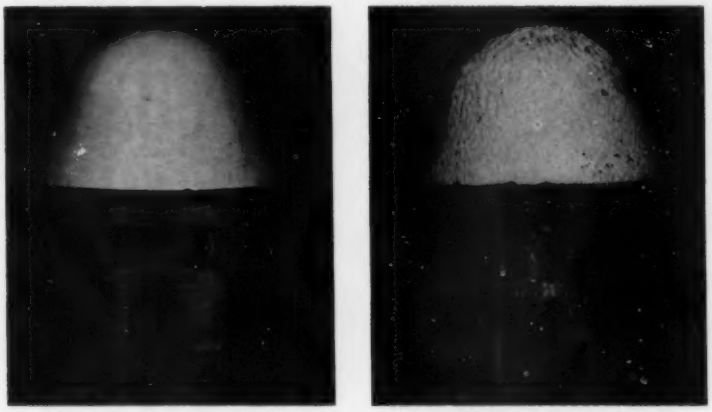


FIG. 5: Slip cast amorphous silica nose cone before and after test. Test conditions: stagnation heat flux—330 B.t.u./ft.²-sec.; stagnation gas temperature—2700° K.; and gas velocity—6700 FPS.

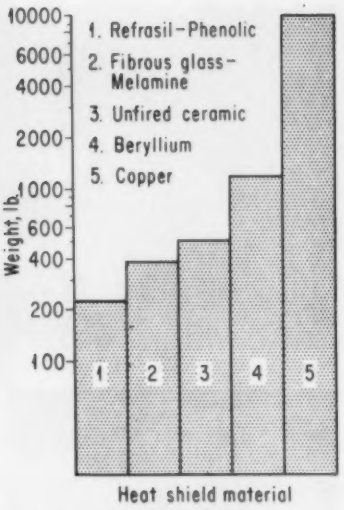


FIG. 6: Estimated total heat shield required to maintain inner surface temperature below 500° K. for a selected IRBM nose cone. The authors are indebted to Robert R. Head, Army Ballistic Missile Agency, for these data.

figure demonstrates why we have devoted most of our efforts to the ablation technique.

Ablation test methods

Although considerable effort has been devoted to the analytical approach and to a consideration of ablation mechanism in recent years, the early ABMA approach to the nose cone materials problem was largely experimental.

The exhaust of a rocket motor was the most satisfactory device available for simulating aerodynamic heating on re-entry bodies at the beginning of the ABMA program, and still is the only device for simulating aerodynamic heating on large shapes. Several liquid propellant rocket motors, graduated to provide the most information with the least cost, were used for systematic screening of potential nose cone materials. Initial screening was done with a rocket motor referred to as the 4-HT, a motor having a rectangular nozzle measuring 1 by 4 in. at the exit. With this motor, flat plates 4 in. square were tested at a heat flux of 100 B.t.u./ft.²-sec. and an exit gas velocity of 6700 ft./sec. To provide this heat flux, test plates were exposed at a 45° angle to the exhaust. Obviously, the heating rate can be varied by changing the angle of exposure of the sample. After initial screening of relatively cheap flat plates, nose cone shapes of promising materials were tested in other motors. Using a family of motors, we have simulated heating rates in the range of 100 to 2500 B.t.u./ft.²-sec.

Programming heating rates with time in a rocket motor exhaust is impractical. For example, simply moving the model back and forth in the exhaust would not give the desired results, since velocity and pressures at the model vary with the model's position in the exhaust. If the test cone can be exposed to the total heat input experienced by a re-entering nose cone in a reasonably comparable time, the results are comparable. Fortunately, this is practical in the case of ballistic missiles. Figure 7, right, represents a heat transfer rate curve for a typical ballistic missile and a satisfactory test environment. This type of testing on full-scale hardware has been very effective at ABMA.

Ablation of plastics

Figure 8, right, represents the equilibrium situation in an ablating, reinforced plastic material. The crust is essentially inorganic, but may contain minute particles of coke and partially decomposed resin under certain conditions of testing. The charred layer, which has lost most of the volatile material, constitutes a very hot reaction zone for the pyrolysis of the resin that migrates toward the surface. The next layer caused by the incipient decomposition of the resin is defined by a discoloration. This layer grades into unaffected material. These three layers constitute the ablation

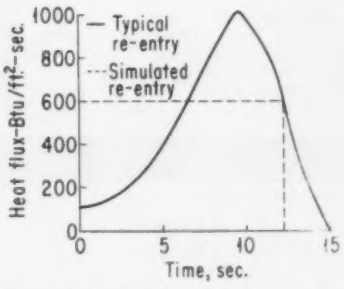


FIG. 7: Stagnation aerodynamic heating; pattern of heat transfer curve of missile during typical re-entry and curve of simulated re-entry during test of cone in rocket motor exhaust.

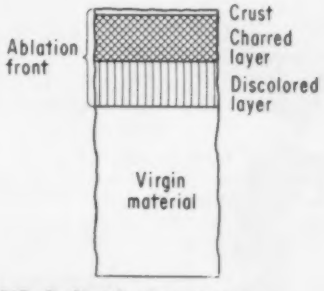


FIG. 8: Sketch of cross section of tested materials showing ablation front.

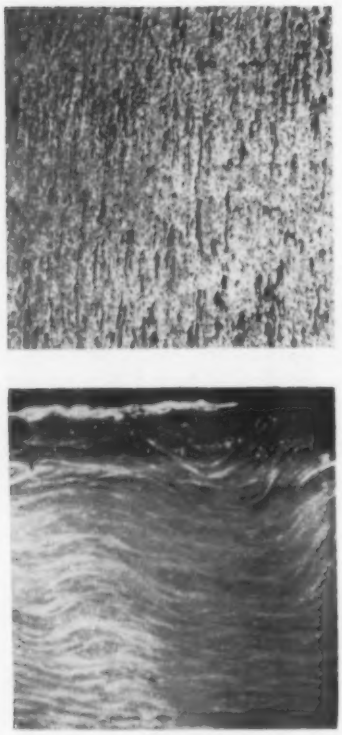


FIG. 9: Surface (top) and cross section of ablation test specimen.

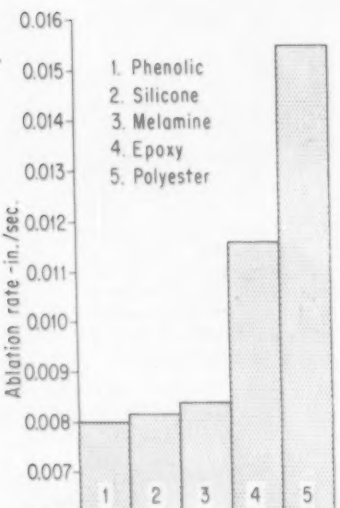


FIG. 10: Ablation rates of fibrous glass (Type E) reinforced plastics at constant heat flux. Heat flux equals 100 B.t.u./ft.^{2}-sec.

front, which moves inward steadily during equilibrium ablation. Figure 9, left, is a photograph of the surface and cross section of a plug from a test specimen.

For a more accurate definition of the thickness of the front, an analysis such as shown in Table I, p. 140, was used. Succeeding layers, beginning from the outer surface, from a typical test specimen were analyzed for nonvolatile content. A nonvolatile residue equivalent to the parent material locates unaffected material. Assuming exposure of only seconds, the fact that the resin does not decompose detectably suggests a maximum temperature for the bottom of the front.

Numerous reinforced plastics were evaluated as ablating materials. Phenolic resins appeared superior in our tests. Figure 10, below, is a comparison of the ablation rates of several glass-fiber-reinforced (Type E) resins under one test condition. Ablation rate has been shown to be a function of heat flux as well as the type and orientation of reinforcement and other parameters. Thus, it is hazardous to characterize one system as superior on the basis of one set of test conditions.

Figure 11, below, compares a few reinforced plastic systems tested under varying heat flux conditions. The heat of ablation as used herein was determined experimentally and refers simply to the total heat per unit of material ablated. In the figure are shown the effects of three different reinforcements as well as three different fabrication techniques. At the lower heat flux only, the fabric lay-up for which data are shown was less efficient than the other schemes due to the thicker ablation front and the resulting tendency to delaminate. Every case demonstrates that ablation efficiency increases with increasing heating rate.

The ablation rate does not tell the whole story of heat penetration. The thickness of the ablation front depends not only upon the material but also upon the conditions of test. Figure 12, p. 140, compares the thickness of crust and char combined (not the entire front) for several materials at constant test conditions. Under these test conditions, Refrasil-phenolic with the highest heat of ablation (lowest ablation rate, see Fig. 11) has the thickest crust and char. Thus, it is conceivable that at the lower heat fluxes, heat might penetrate as deeply in Refrasil-phenolic as in a material having a lower heat of ablation but a thinner ablation front. This emphasizes that there is not a generally applicable ablation material. Figure 13, p. 140, demonstrates how the thickness of crust and char decreases with increasing heat flux for a glass-fiber-reinforced melamine resin. This is a general tendency for the materials that we have tested.

The effective heat of ablation usually has been related to the composition of material involved. However, several other parameters influence the effective heat of ablation; for example, molding pressure, cure cycle, and orientation of reinforcement. Initially, it

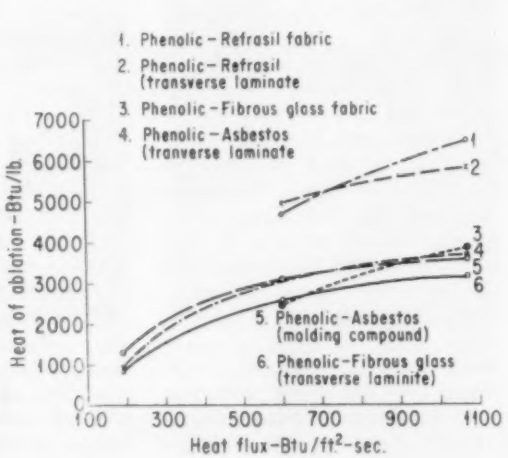


FIG. 11: Heat of ablation versus heat flux for several reinforced plastic materials.

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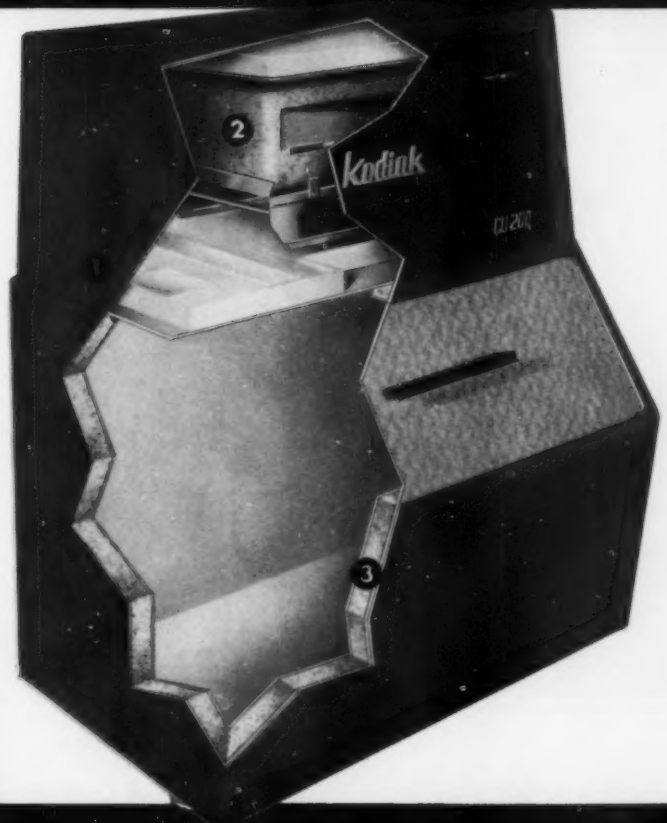
3 **1:1 RATIO FOR FOAM** "With ADM's rigid foam resins, insulating the Kodiak is no trick at all. We can use a 1 to 1 mix, which is ideal for handling with virtually any equipment. Temperature isn't critical either with these low viscosity resins. We get excellent foam uniformity and good cure in our insulation without the need of heating or cooling the resin lines. No other resin gives you so much latitude."



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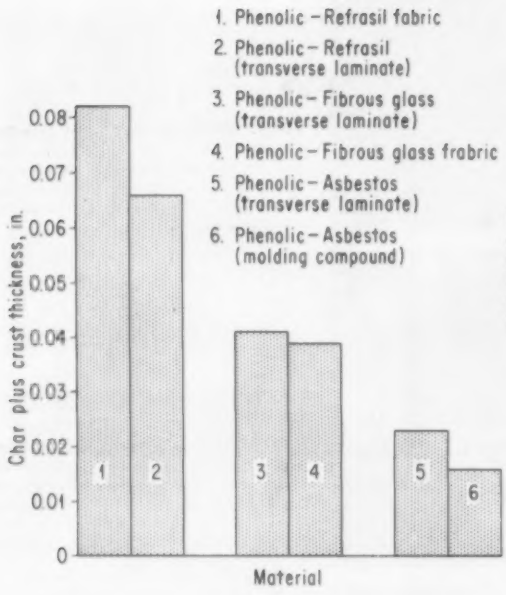

FIG. 12: Char plus crust thickness versus various reinforcements in phenolic resin. Heat flux equals 10⁷0 B.t.u/ft.²-sec.

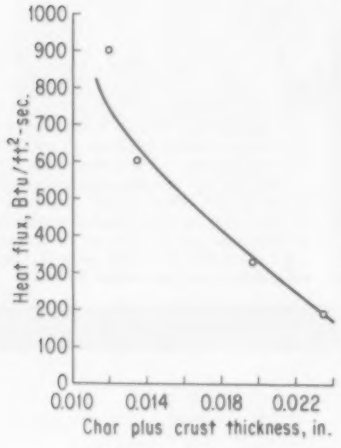

FIG. 13: Char plus crust thickness versus heat flux for fibrous glass reinforced melamine resin.

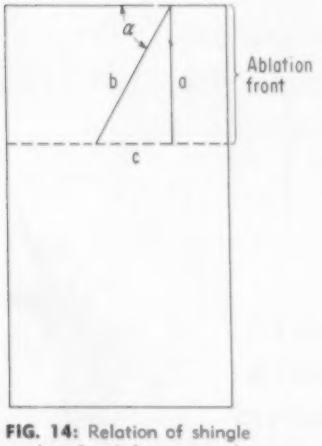

FIG. 14: Relation of shingle angle of reinforcement, b, to ablation front thickness.

appeared that the ideal nose cone material would consist of an aggregate of very high heat capacity supported in a matrix of very low thermal conductivity. This would indicate a powdered metal such as beryllium in a resinous matrix. It was demonstrated that this approach is not practical since the aggregate of high heat capacity cannot be held in place long enough to utilize its capacity for absorbing heat.

A smooth ablating surface is important from a practical standpoint. Minor surface roughness under the combined influence of heat and aerodynamic friction has resulted in catastrophic failure of test specimens. In order to provide a smooth ablating surface, powdered silica was dispersed in a resin. Rather than providing a smooth surface, this technique allowed the material to be removed in chunks. The deficiency of the laminate oriented parallel to the surface was indicated by the test pictured in Fig. 1.

Thus, it became evident that it would be necessary to anchor the surface by allowing the reinforcement to extend to a depth in the resin where its strength was not affected appreciably. This can be accomplished by the hair brush technique in which fiber reinforcement is oriented perpendicular to the surface. This technique, sometimes called transverse lamination, provides an effective ablation system; however, structural strength is sacrificed. The compromise is the shingle effect, the angle (α) of the reinforcement with respect to the surface being determined by the intended application. If b in Fig. 14, below, represents the fiber (or fabric) and a represents the width of the ablating front, it is obvious that the fiber or fabric must be long enough to permit b to form the hypotenuse of a right triangle with a as one leg and the bottom of the ablating front as the other leg. This is necessary since the strength of the resin in the ablating front is not adequate to hold glass or ceramic fibers in place against the shear forces on a nose cone ablating surface. For an application in which the heat flux is low, resulting in a thicker ablating front, it is even more important than in the case of a very high flux to avoid lami- **(To page 211)**

Table I: Analysis of layers of test plug from an ablation test specimen of reinforced plastic

Thickness of layer	*Nonvolatile at 600° C.*	*Remarks*
in.	*wt. %*	
0.030	68.14	Crust and charred layer
0.015	62.83	Discolored layer
0.020	61.20	
0.010	61.29	
0.010	61.25	
0.029	54.99	
0.025	52.59	Depth of heat-affected material
0.026	51.82	
0.024	51.84	
Parent material	51.78	

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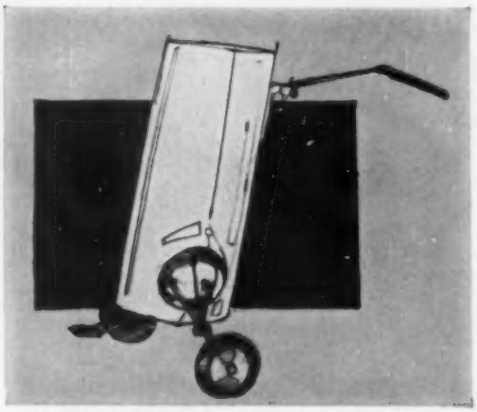

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Tung oil and its derivatives in polyesters

By Frank B. Root* and Roger W. Amidon*

Although tung oil has low miscibility with ordinary polyesters, it has the effect, when mixed with the resin, of shortening gel-time and decreasing the temperature rise in room temperature cure. Improved tung oil compatibility can be obtained by modifying the unsaturated polyester with rosin.

Tung oil can be completely reacted with a polyester such as propylene phthalate-maleate and results in an increase in viscosity and improved styrene compatibility. When the oil is added to the polyester charge or at any time up to the point at which the esterification reaction is ⅔ complete, clear resins are obtained. When added at esterification temperature after the reaction is about ⅔ complete, hazy polyesters are produced.

Relatively large amounts of tung oil can be incorporated in an unsaturated polyester by partial reaction to a homogeneous stage at a temperature of 100 to 130° C. A tung-oil-modified polyester of this type is a heat-hardening resin and can be used in baked coatings and casting compositions.

Tung oil has had great prominence in varnish making in this country. Since its introduction at about the turn of the century, spar varnish made from ester gum and tung oil was the initial major use, followed about 1922 by the so-called 4-hr. varnishes using tung oil and rosin-modified phenolic resins. However, substitute oils (dehydrated castor oil and the "soft-drying oils" treated with maleic anhydride), which approach tung oil in hard-drying and water resistance, have usurped some of the field once occupied by tung oil. Although tung oil is still the best drying oil, it no longer occupies its former unique position. Further uses are needed to consume the potential supply that is available to industry in the U. S.

It was the purpose of the present investigation to seek uses of tung oil in polyesters, hoping to enhance the properties of these resins. A polyester resin consists essentially of an unsaturated polyester prepared from an α-β unsaturated dicarboxylic acid, a glycol or glycols, and usually another dibasic acid that acts as an extender and may also contribute to the final physical properties of the cured resin. A second component is a vinyl monomer which may copolymerize with the unsaturation in the polyester. The most commonly used monomer is styrene. The curing reaction is initiated by a free radical, which may come from thermal or catalyzed decompositions of a peroxide. The resulting crosslinked structure is presented schematically in Fig. 1, below. Lines drawn away from the structure without attached groups represent links to the rest of a thermoset polymer.

By lengthening the group R or by including therein an ether linkage, the resulting cured resin becomes more flexible or of lower modulus. Examples of R may be found in ethylene glycol, propylene glycol, diethylene glycol, and other glycols. If R' is the ortho phenylene group, which implies the use of phthalic acid in the polyester, then the resin will have a relatively high modulus. Compatibility of polyesters with monomers may be profoundly affected by alteration of either R or R'.

Tung oil is a triglyceride, the mixed fatty acids of which contain from 75 to 80% eleostearic acid (9,11,13-octadecatrienoic acid), which has three conjugated double bonds, and from 20 to 25% of a mixture of relatively inert C_{18} fatty acids, some saturated and some unsaturated but without conjugated double bonds. Tung oil undergoes the Diels-Alder reaction in which the reactivity of the oil is due to the conjugated triene system in the eleostearate chain. It is worthy of note that two of the double bonds have the *trans*-configuration, which provides a structure more susceptible to dienophilic attack (1).[1]

The use of tung oil in polyester resins was studied from two different angles: 1) the effect of mixing tung oil or a tung oil derivative with the resins and 2) the effect of modifying the polyester by the reaction (complete or partial) of tung oil or a tung oil derivative therewith.

Tung oil mixed with polyesters

Tung oil is not compatible with polyesters such as propylene phthalate-maleate in styrene so-

[1]Numbers in parentheses link to references at end of article, p. 150.

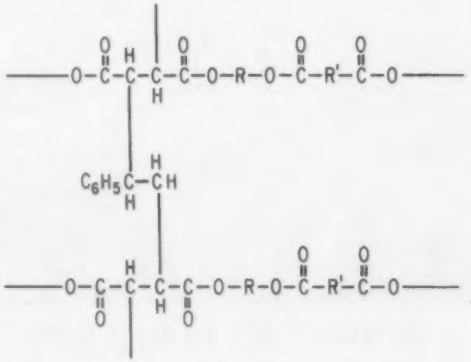
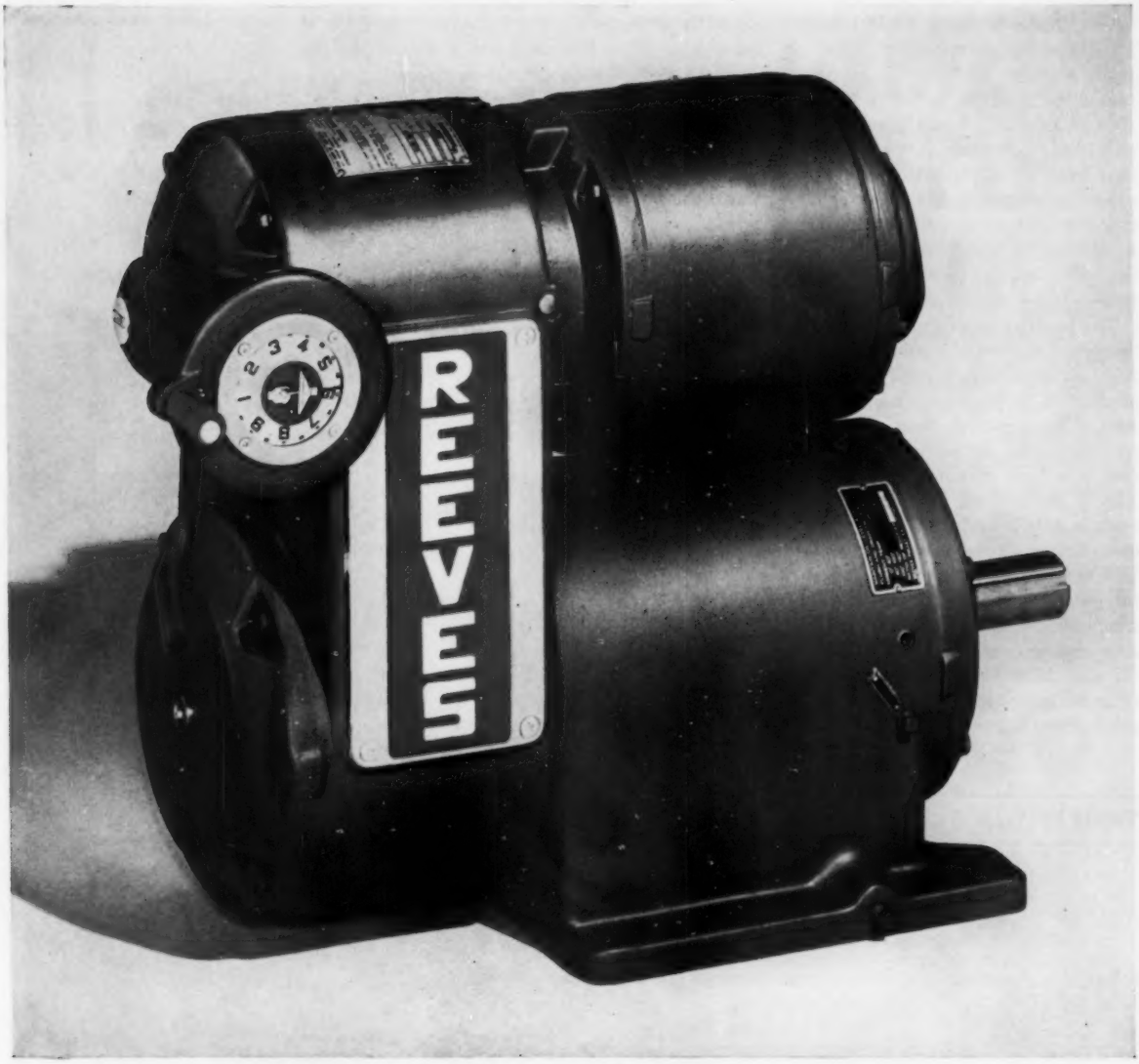


FIG. 1: The chemical structure of crosslinked polyester resin.

*Naugatuck Chemical Div., United States Rubber Co.

A report of work done under contract with the U. S. Department of Agriculture and authorized by the Research and Marketing Act of 1946. This contract was supervised by L. A. Goldblatt of the Southern Utilization Research and Development Division of the Agricultural Research Service.



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lution. The addition of as little as 1% shows up as turbidity in the resin solution and in the cured resin; the addition of more than 10% of tung oil causes precipitation of the polyester. It was found that tung oil mixed with a polyester has a pronounced effect on room-temperature gelation with a ketone peroxide and cobalt naphthenate, and on the exothermic heat developed on curing.

The usual course in the room-temperature cure of a polyester is: first, an induction period; then a slight rise in temperature accompanied by gelation; then a temperature rise at an accelerated rate to a high maximum followed closely by cooling. In general, a resin is fully cured after the maximum temperature has been passed. However, in the presence of tung oil gelation is gradual, the peak temperature is lower, and the temperature remains at the peak for some time. Castings containing tung oil are very soft when they reach room temperature, but they harden progressively over a period of a day or so and eventually become cured. Hardening can be hastened by baking.

The effect of tung oil in comparison with linseed oil when mixed with polyester-styrene on gelation and exotherm is shown in Fig. 2, p. 150. Linseed oil was selected because it is an unsaturated oil that is immiscible with the resin but does not contain conjugated unsaturation. Linseed oil retards gelation and reduces exotherm somewhat. This would be expected if the oil acts as a diluent. On the other hand, tung oil accelerates gelation, and its effect on exotherm is much greater than that produced by mere dilution. Both oils produce cloudy castings.

Miscibility of tung oil derivatives

Since a compatible substance that shows the same effects as tung oil was desired, various tung oil derivatives were tested. When tung oil is reacted with maleic anhydride or a dialkyl fumarate in such proportions as to retain unreacted eleostearate groups or when tung oil is alcoholized with glycols, the products are no more compatible than tung oil. This also applies to isomerized (*beta*) tung oil and to heat-bodied tung oil. Blown tung oil showed slight but actually not a sufficient improvement in compatibility.

Methyl esters of tung fatty acids have greater solubility (5%) in a styrene solution of propylene phthalate-maleate than tung oil; however, the cured resin is turbid. Blown methyl esters (with air at 130°C. for 3.5 hr.) are compatible and produce a clear casing, but the effect on cure is not as great as would be desired.

Since cured resins that contained the methyl esters were cloudy or turbid, it was deduced that the latter were thrown out of solution as a second phase as curing proceeded. Allyl eleostearate possesses the necessary unsatura-

Table I: Physical properties of polyesters containing tung oil

No.	Styrene %	Tung oil %	Acid No.	Viscosity p.	110° C. cure[a] Gel. time sec.	110° C. cure[a] Exotherm peak °C.	Tensile strength p.s.i.	Elongation %	Rockwell hardness L	Rockwell hardness M	Water abs. (24 hr.) %	Impact strength[b] in.-lb.
					Ethylene glycol phthalate-maleate							
1	25	0	26.6		54	173	11,200	2.9	119	108	0.19	14.5
2	25	3	28.8		53	159	10,500	2.6	119	111	0.17	17
3	30	6	25.8		57	164	10,700	2.9	119	110	0.21	16
4	33	10	30.8		55	172	10,100	3.0	117	107	0.18	8.7
5	30	6[c]	30.1		61	169	11,870	3.1	119	110	0.17	11
					Ethylene glycol phthalate-fumarate							
6	25	0	31.2		48	176	8,620	1.7	121	113	0.18	17
7	25	3	29.7		50	167	9,470	1.8	122	114	0.17	19
8	30	6	28.4		56	178	11,370	2.8	120	111	0.19	14.5
9	33	10	26.8		60	168	10,790	3.3	119	108	0.19	5.5
10	30	6	28.5		54	172	11,330	3.07	121	111	0.21	8.7
					Propylene glycol phthalate-maleate							
11	33	3	28.7	10.0	74	164	8,750	1.59	119	106	0.18	6.5
12	33	6	27.7	13.1	77	155	9,100	2.0	119	104	0.18	5.5
13	33	10	28.4	30.7	80	145	8,000	1.9	113	106	0.18	12
14	33	0	28.8	8.5	76	168	6,100	1.1	119	108	0.19	12+
15	33	6[c]	28.5	39.0	72	157	8,700	2.3	117	106	0.17	4.5
					Propylene glycol phthalate-fumarate							
16	33	0	28.2	7.6	71	175	8,600	1.8	120	112	0.22	6
17	33	3	25.9	12.1	70	164	12,000	2.9	119	110	0.19	13
18	33	6	27.6	14.4	74	160	10,600	2.3	118	108	0.21	10.5
19	33	10	25.9	23.7	75	156	11,200	2.5	117	104	0.22	13
20	33	6[c]	25.0	12.6	73	168	9,700	2.1	118	106	0.20	7.5

[a]Test made with 1.5% benzoyl peroxide. [b]Measured by determining the distance of fall of a 0.5-lb. steel ball necessary to break a 6 by 6 by 0.125-in. casting supported at the edges. [c] The tung oil was reacted with the preformed polyester.

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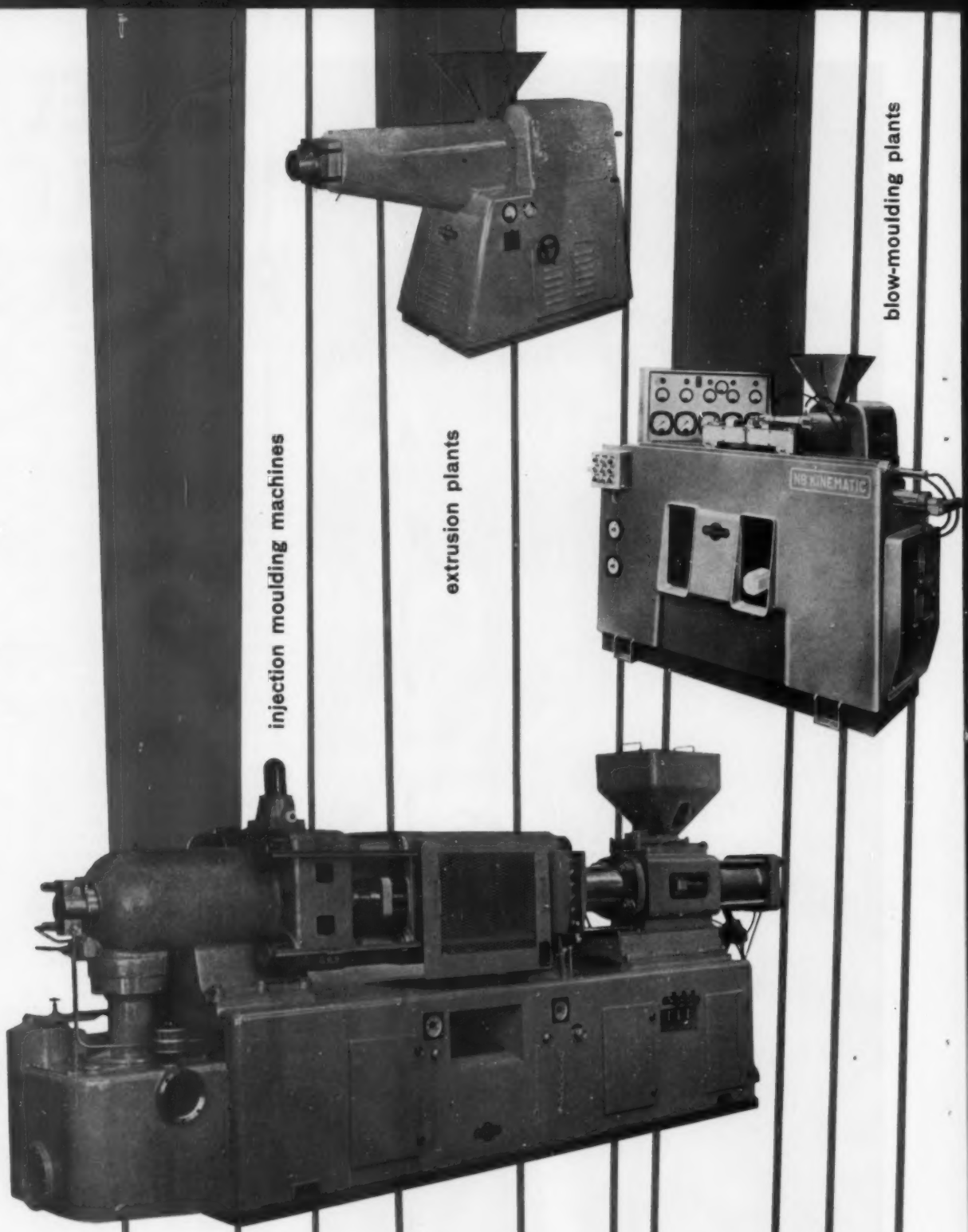

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Table II: Torsional modulus of polyesters containing tung oil and 33% styrene

No.	Tung oil %	Torsional modulus 35° C. p.s.i.	45° C. p.s.i.	60° C. p.s.i.	75° C. p.s.i.	85° C. p.s.i.	100° C. p.s.i.	Heat distortion temp.[a] °C.
				Propylene glycol phthalate-maleate				
11	3	553,600	461,300	369,000	212,900	115,300		86
12	6	663,000	580,000	412,000	200,900	91,500		84
13	10	575,000	544,400	340,000	132,000	53,400		79
14	0	694,000	615,000	471,000	236,000	141,600		90
15	6[b]	582,300	528,000	398,000	236,800	117,000		88
				Propylene glycol phthalate-fumarate				
17	3	533,000	480,000	360,000	213,000	147,500	54,500	92
18	6	582,000	560,000	378,000	182,000	110,000		86
19	10	561,000	503,000	347,600	151,500	86,500		83
20	6[b]	610,000	568,000	411,000	227,000	150,000	50,300	93

[a]Temperature at which modulus is 100,000 p.s.i. (by extrapolation). [b]Tung oil added near end of reaction.

tion for copolymerization and should react into the resin. Allyl eleostearate was found to show the same general effect as tung oil with the added advantage that it produces a clear cured casting, but the maximum amount that can be added to a styrene solution of propylene phthalate-maleate is about 2.5 percent.

Modification of polyesters to improve tung oil miscibility

In order to get a more pronounced modification of cure, it was found necessary to increase compatibility by varying the polyester resin. The miscibility of tung oil with styrene solutions of a large number of polyesters, in whcih *R'* as shown in Fig. 1 was varied, was investigated.

Omitting the phthalic group or substituting various other dibasic acids had no pronounced effect; better results were obtained with rosin-maleic anhydride adduct. The use of rosin with tung oil in varnishes is well known. Rosin is known to increase oil solubility of certain resins. It was found that 4 to 5% of tung oil is clearly miscible with a styrene solution of the polyester made from 2 moles of maleic anhydride, 2 moles of a glycol, and 1 mole of rosin (considered as abietic acid). However, the addition of 10% of the oil causes turbidity.

The exotherm curves for the rosin-resin and for the rosin-resin mixed with tung oil and with linseed oil are shown in Fig. 3, p. 150. Methyl esters of tung fatty acids and allyl eleostearate give curves almost identical with tung oil. The gel time with 5% tung oil or tung esters is somewhat indefinite because the increase in viscosity is very gradual; however, the curious fact was noted that the peak exotherm was reached before the resin gelled. Tung oil and tung esters behave similarly, although the oil seems to be somewhat more effective in decreasing gel time. It is again noted that linseed oil behaves differently than tung oil. Gelation is more definite, maximum temperature rise occurs after gelation, the peak temperature is higher, and the period at peak temperature is less prolonged. The casting containing linseed oil was cloudy.

Polyesters modified with tung oil

The Diels-Alder reaction of tung oil with maleic anhydride has been known for a long time (2). However, reactions of tung oil with fumaric acid and with fumaric and maleic esters are not so well known. Tung oil was incorporated in ethylene phthalate-maleate, ethylene phthalate-fumarate, propylene phthalate-maleate, and propylene phthalate-fumarate, the formula in each case being 2.1 moles of glycol, 1 mole of phthalic anhydride, and 1 mole of maleic anhydride or fumaric acid. Varying amounts of tung oil were used. Ethylene phthalate-maleate gelled with 15% (based on the polyester) of tung oil before the reaction was quite complete. Polyesters containing 3, 6, and 10% of tung oil were prepared together with controls containing no oil, and were blended with styrene.

In the ethylene glycol series it was found that tung oil increases the styrene tolerance of the polyester. Ethylene phthalate-maleate is not compatible in a composition containing 33% styrene; a practical amount is 25 percent. However, the incorporation of 10% of tung oil in the polyester raises the practical limit of styrene to 33 percent. In this particular case the increased styrene content offsets the cost of the added tung oil.

Table I, p. 146, shows some physical properties of unsaturated polyesters reacted with tung oil. The viscosity was not measured in the ethylene glycol series because the styrene content varied. In the propylene glycol series the amount of styrene was constant at 33%, and the viscosity was found to increase with the amount of tung oil incorporated. Table II, above, shows the torsional modulus of polyesters described in Table I.

Polyesters modified with maleic and fumaric adducts of tung oil, tung oil acids, various preparations of *beta* tung oil, heat-bodied tung oil, and tung oil monoglycerides, and with diallyl fumarate adducts of tung oil and of *beta* tung oil, *alpha*-eleostearic acid, methyl esters of tung fatty acids, propiolactone adduct of tung oil, aromaticized propiolactone adduct of eleostearic acid, acrylonitrile adduct of tung oil, butyl acrylate adduct of tung oil, and

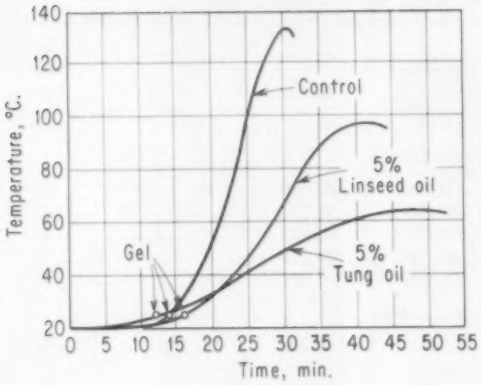

FIG. 2: Effect of tung and linseed oils on cure time of polyester-styrene (propylene phthalate-maleate 67, styrene 33, oil 5, methyl ethyl, ketone peroxide 0.6, as well as cobalt napthenate 0.6 parts).

cyclopentadiene adduct of tung oil were evaluated. None merited more extensive investigation.

Prevention of haze

No difficulty was found in preparing homogeneous compositions when the tung oil was added at the beginning of the reaction. However, when tung oil (6%) was reacted with the preformed polyester, the resin and its styrene solution were slightly hazy in every case. A series of propylene phthalate-maleate resins was prepared to which the tung oil was added at advancing points of esterification. If the tung oil was added to the polyester charge at any time before the esterification was ¾ complete, a clear resin was obtained. This corresponds to an acid value of about 100 or a relatively low molecular weight. If tung oil was added beyond this point, a hazy resin was obtained. It is thought that turbidity is caused by microscopic gel particles.

Delaying the addition of the oil until the esterification is about ¾ complete (rather than adding the oil at the start) is of practical value. By the time ¾ of the water has come off the rate of water evolution is relatively slow and the addition of tung oil causes no foaming such as occurs when the oil is added at the start. In particular, the addition of tung oil at the beginning of a fumaric acid reaction causes severe foaming.

Polyesters containing partially reacted tung oil

Tung oil can be reacted with an unsatufated polyester at a temperature as low as 100° C. The low temperature reaction of tung oil and polyester is slower than the reaction that takes place when the oil is added at esterification temperature; however, a greater amount of tung oil can be used, if more of it is desired, because the reaction can be completely stopped at a soluble stage in the process by immediately blending the polyester with styrene.

Applications

There is a possibility that unsaturated polyesters modified by reaction with tung oil may have application in the field of baked coatings. The partial reaction product of more than 12% of tung oil with a glycol maleate is a heat-convertible resin, i.e., when the resin is heated it hardens like a thermosetting resin. The rosin-modified polyester mentioned previously behaves similarly. In contrast with other film-hardening reactions, such as oxidation, polymerization, or condensation, the hardening is by way of the Diels-Alder reaction. No volatile material is given off as in a condensation reaction such as esterification. No driers are needed as in an ordinary varnish. This is believed to be a new hardening process in baked coatings.

The following facts were noted during the investigation: 1) baking at 150° C. tends to give a wrinkle finish, and the wrinkling is increased by the addition of driers; 2) wrinkling can be prevented through the addition of an anti-oxidant, such as hydroquinone.

Films of propylene phthalate-maleate or rosin-maleate resins partially reacted with 25% of tung oil do not air-dry during 3 days. However, when baked for 1 hr. at 150° C. they form smooth, clear, tough films. When exposed to water for 24 hr., a baked film showed no spotting.

A partial reaction product of tung oil and an unsaturated polyester can also be used as a casting or potting composition.

In conclusion, then, tung oil has the following gross effects on polyester resins: 1) modifies cure promoted at room temperature by decreasing heat of polymerization; 2) improves styrene compatibility when used to modify the polyester; 3) increases viscosity of resins when reacted with the polyester; 4) creates a heat-convertible resin when partially reacted with an unsaturated polyester.

References

1. R. F. Paschke, W. Tolberg, and D. H. Wheeler, Journal of the American Oil Chemists' Society *30*, 97-99 (1953).

2. R. S. Morrell and H. Samuels, Journal of the Chemical Society *1932*, 2251-2254.—**End**

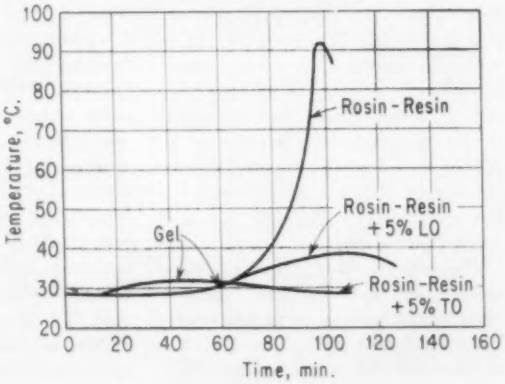

FIG. 3: Effect of tung and linseed oils on cure of rosin-modified polyester (rosin-modified polyester 67, styrene 33, tung or linseed oil 5, methyl ethyl ketone peroxide 0.6, cobalt naphthenate 0.5 parts).

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Plastics production in 1959 grouped by chemical composition*

Material	Production[a] 1000 lb.	Unit value per lb.[b] dollars
Grand total	**6,018,458**	—
BENZENOID RESINS		
Total	**2,646,158**	**0.28**
Coumarone-indene and petroleum polymer resins	**318,330**	**.10**
Epoxy resins, total	**56,821**	**.62**
Unmodified (condensation products of phenol and derivatives with epoxy compounds)	49,152	.62
Modified (with hardening agents and esterified with fatty acids)	7,669	.62
Phenolic and other tar acid resins, total	**624,793**	**.28**
Unmodified, total	**570,041**	**.28**
Cresols-formaldehyde	7,073	.36
Cresylic acid-formaldehyde	8,888	.29
Phenol- (and substituted phenol)- formaldehyde	502,219	.27
Resorcinol-formaldehyde	4,932	.63
All other	46,929	.26
Modified, total	**54,752**	**.29**
Phenol- (and substituted phenols)- formaldehyde with modifiers (except rosin)	25,112	.28
Rosin and rosin esters modified with phenolic and other tar acid resins (hard resins)	24,332	.23
All other	5,308	.54
Phthalic alkyd resins, total	**472,755**	**.32**
Unmodified	349,202	.31
Modified	123,553	.36
Polyester resins[c]	**180,672**	**.36**
Polyurethane and diisocyanate resins	**4,720**	**.52**
Styrene resins, total	**976,937**	**.28**
Polystyrene	626,630	.24
Styrene-acrylonitrile copolymer	32,178	.35
Styrene-alkyd polyesters (for protective coatings only)	25,148	.43
Styrene-butadiene copolymer (containing 50% or more styrene), total	224,126	.35
Latexes	130,485	.28
Other	93,641	.47
Styrene-divinylbenzene copolymer	21,347	.62
All other styrene resins	47,508	.28
All other benzenoid resins[d]	**11,130**	**.51**
NONBENZENOID RESINS		
Total	**3,214,212**	**0.35**
Alkyd resins, except phthalic, total	**87,186**	**.32**
Unmodified, total	**34,369**	**.41**
Modified, total	**52,817**	**.26**
Rosin and rosin esters, modified with maleic and fumaric acids only (hard resins)	41,687	.23
All other	11,130	.40
Polyamide resins	**38,105**	**1.08**
Polyethylene resins, total	**1,194,987**	**0.32**
High-pressure process	1,079,580	.32
Low-pressure process	115,407	.33
Rosin modifications, total	**73,523**	**.20**
Rosin and terpene adduct resins	**8,132**	**.33**
Rosin and rosin esters, unmodified (Ester gums), total	**60,478**	**.19**
Esterified with glycerol	26,286	.20
Esterified with other alcohols (methanol, glycols, pentaerythritol, etc.)	34,192	.18
All other	4,913	.19
Silicone resins	**5,027**	**2.97**
Urea and melamine resins, total	**420,742**	**0.30**
Urea-formaldehyde type	277,652	.23
Melamine-formaldehyde type	143,090	.44
Vinyl and vinyl copolymer resins, total[e]	**1,166,465**	**.31**
Polyvinyl acetate	139,363	.31
Polyvinyl chloride and copolymer resins (containing 50% or more polyvinyl chloride)	905,323	.25
All other vinyl resins[f]	121,779	.77
All other nonbenzenoid resins[g]	**228,177**	**.73**
CELLULOSE PLASTICS		
Total	**158,088**	—
Cellulose acetate and mixed esters, total	**155,108**	—
Sheets, continuous, under 0.003 in. gage	19,482	—
Sheets, continuous, 0.003 in. gage and over	22,581	—
All other sheets, rods, and tubes (including other cellulose plastics)	9,052	—
Molding and extrusion materials (including other cellulose plastics)	103,993	—
Nitrocellulose sheets, rods, and tubes	**2,980**	—

*Source: U. S. Tariff Commission.

[a]For the purpose of this report, "dry basis" is defined as the total weight of the material, *including* resin, plasticizers, fillers, extenders, colors, and stabilizers, and *excluding* water, solvents, and other liquid diluents.

[b]Calculated on rounded figures.

[c]Polyester resins, for the purpose of this report, include unsaturated alkyds copolymerized with monomers such as styrene, and polyallyl resins such as diallyl phthalate, and allyl diglycol carbonate. Styrene-alkyd polyester for protective coatings are included under *Styrene resins.*

[d]Includes data for aniline-formaldehyde, toluenesulfonamide, and other benzenoid resin materials not specifically classified.

[e]Based on resin content only.

[f]Includes data for polyvinyl alcohol, butyral, and formal, and for copolymers containing less than 50% polyvinyl chloride.

[g]Includes data for acrylic and other nonbenzenoid resin materials.

(More statistics appear on p. 154)

Plastics production in 1958 and 1959 grouped by classes and uses[a]

Material	1959	1958
	1000 lb.	1000 lb.
Grand total	**6,018,458**	**4,658,987**
Cellulose plastics, total	**158,088**	**141,359**
Cellulose acetate and mixed esters:		
Sheets, continuous, under 0.003 in. gage	19,482	17,036
Sheets, continuous, 0.003 in. gage and over	22,581	18,421
All other sheets, rods, and tubes (including other cellulose plastics)	9,052	9,193
Molding and extrusion materials (including other cellulose plastics)	103,993	93,772
Nitrocellulose sheets, rods, and tubes	**2,980**	**2,937**
Phenolic and other tar-acid resins, total	**624,793**	**487,862**
Molding materials	229,022	167,417
Bonding and adhesive resins for—		
Laminating	75,597	62,688
Coated and bonded abrasives	16,208	12,107
Friction materials	16,872	13,402
Thermal insulation	51,716	44,803
Plywood	61,455	51,513
All other bonding and adhesive uses	63,415	40,162
Protective coatings:		
Unmodified	25,251	24,247
Modified, except by rosin	4,786	4,185
Rosin esters modified by phenolic and other tar-acid resins (hard resins)	29,112	25,547
Resins for all other uses	51,359	41,791
Urea and melamine resins, total	**420,742**	**349,214**
Textile-treating and textile-coating resins	46,094	50,775
Paper-treating and paper-coating resins	30,381	24,702
Bonding and adhesive resins for—		
Laminating	36,382	32,002
Plywood	106,468	101,565
All other bonding and adhesive uses	27,663	11,585
Protective coating resins, straight and modified	38,566	32,454
Resins for all other uses, including molding	135,188	96,131
Styrene resins, total	**976,937**	**763,057**
Molding materials, total	**667,789**	**475,597**
Straight polystyrene	319,200	—
All other	348,589	—
Protective coating resins, straight and modified[b]	81,642	110,602
Textile- and paper-treating and coating resins	63,155	—
Resins for all other uses	164,351	176,858

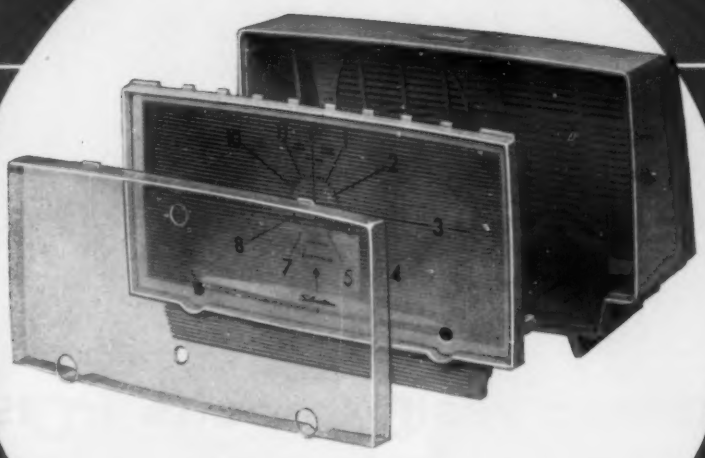
[a]Source: U. S. Tariff Commission. "Dry basis," for the purpose of this report, is defined as the total weight of the material, *including* that of resin, plasticizers, fillers, extenders, colors, and stabilizers, and *excluding* that of water, solvents, and other liquid diluents.
[b]Includes data for styrene-alkyd polyester resins.
[c]Based on resin.

Material	1959	1958
	1000 lb.	1000 lb.
Vinyl and vinyl copolymer resins[c], total[d]	**1,166,465**	**869,419**
Polyvinyl chloride and copolymer resins (containing 50% or more polyvinyl chloride) for:		
Film (under 0.010 in. gage)	88,904	74,481
Sheeting (0.010 in. gage and over)	130,178	73,856
Molding and extrusion	305,947	223,665
Textile and paper treating and coating	68,449	64,195
Flooring	153,007	109,765
Protective coatings	31,367	26,647
All other uses	96,506	74,883
All other vinyl resins for:		
Adhesives	59,495	52,101
Protective coatings	25,275	—
All other uses	142,470	129,708
Alkyd resins, total	**559,941**	**502,590**
For protective coatings:		
Phthalic anhydride types:		
Unmodified	348,101	305,197
Modified	120,630	109,296
Polybasic acid types:		
Unmodified	15,224	13,104
Modified (except by rosin)	10,933	11,829
Rosin esters modified with maleic and fumaric acids only (hard resins)	40,099	47,437
For all other uses	24,954	15,727
Rosin esters, total	**73,523**	**58,889**
Unmodified (ester gums) for protective coatings	25,653	27,413
All other modifications for protective coatings and other uses	47,870	31,476
Coumarone-indene and petroleum polymer resins	**318,330**	**267,940**
Polyester resins, total	**180,672**	**117,246**
For reinforced plastics	129,472	91,913
For all other uses	51,200	25,333
Polyethylene resins, total[d]	**1,194,987**	**864,728**
For film and sheeting	344,353	314,989
Molding materials	216,479	—
Extrusion materials	155,049	—
For all other uses	400,367	539,381
Epoxy resins, total[d]	**56,821**	**41,268**
For protective coatings	20,672	—
For all other uses	24,561	—
Miscellaneous plastics and resin materials[e]	**287,159**	**192,318**

[d]Total is based on production; statistics by use are based on sales.
[e]Includes data for acrylic, toluenesulfonamide, and other plastics and resin materials.

(More statistics appear on p. 156)

Precision Molding



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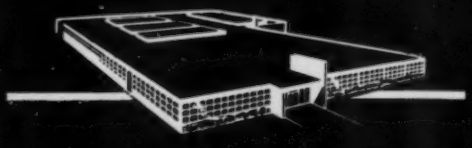

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Synthetic elastomers production in 1958 and 1959[a]

Product	1958 production	1959 production	1959 unit value
	1000 lb.	1000 lb.	per lb.[b]
Synthetic elastomers, total	2,201,950	2,825,339	$0.27
Polybutadiene-styrene type (S-type)	1,752,541[d]	2,210,380	.23
Polyurethane type	—	2,377	1.05
Polybutadiene-acrylonitrile type (N-type)	71,626	96,699	.49
Polychloroprene type (Neoprene)	219,085	279,586	—
Polyisobutylene-isoprene type (Butyl)	117,033	181,458	—
Silicone elastomers	—	5,215	3.94
All other elastomers[c]	41,665[e]	49,624	.34

[a]Source: U. S. Tariff Commission. The term "*Elastomers*" is defined as substances in bale, crumb, powder, latex, and other crude forms, which can be vulcanized or similarly processed into materials which can be stretched at 68° F. to at least twice their original lengths and which after having been so stretched and the stress removed, return with force to approximately their original lengths. [b]Calculated on rounded figures. [c]Includes data for polyalkylene sulfide, polybutadiene, and polyisobutylene elastomers, and for natural rubber modifications. [d]Included small amount of polyurethane type. [e]Included small amount of silicone elastomers.

Synthetic resin imports in 1959[a]

Product	Quantity	Product	Quantity
	lb.		lb.
Synthetic resins, total	3,578,126	Polyester resins	68,552
"Akemi" stone and marble cement	21,494	Polystyrene resins	1,784,565
Phenolic resins	85,971	Polyurethane resins	661,756
Plastic phosphors	2,090	Vinyl resins (with coal-tar plasticizers)	93,958
Polyamide (nylon) resins	757,310	Miscellaneous plastics and resins	102,430

[a]Source: U. S. Tariff Commission.

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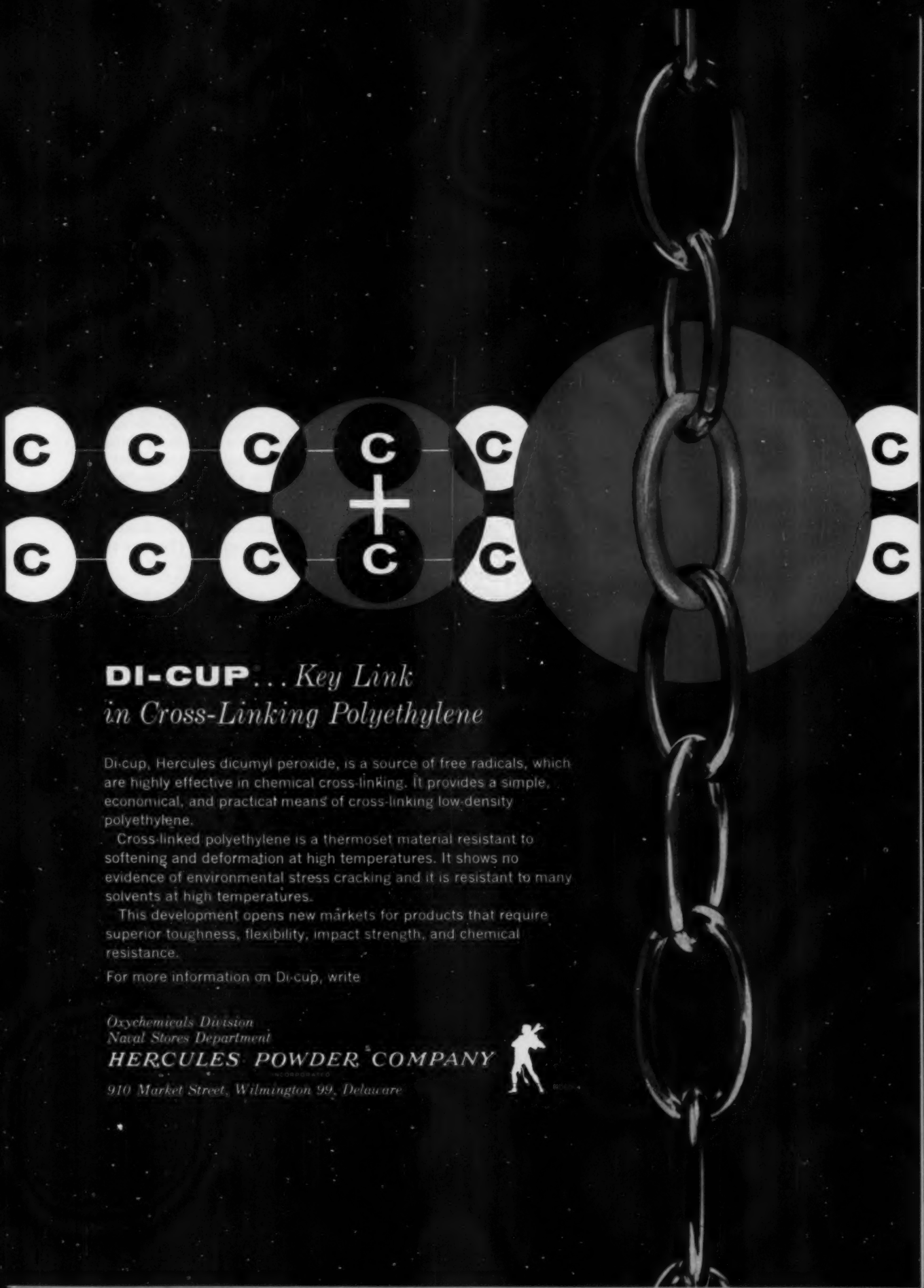

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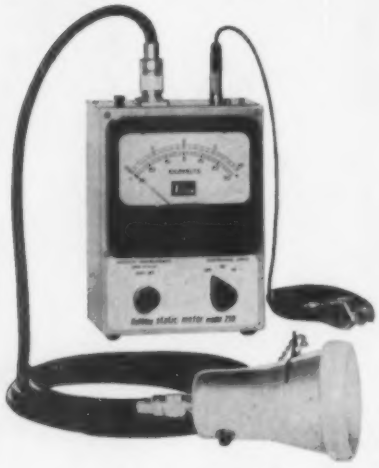

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PLASTICIZER PRODUCTION AND SALES, 1959

By D. H. Bechtold,* P. W. Spink,* W. F. Waychoff,* and S. R. Weber*

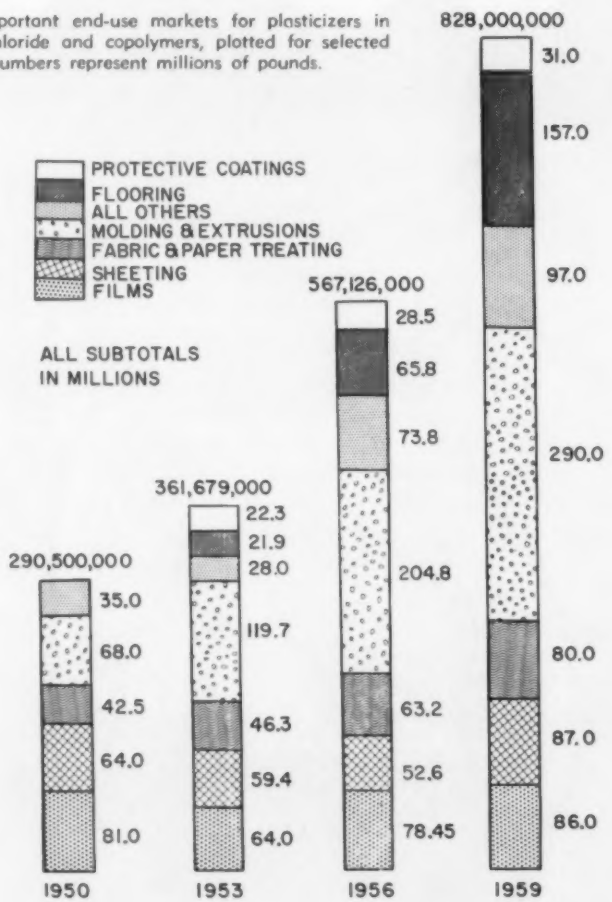
The year 1959 is one which will be long remembered by plasticizer consumers and producers. First of all, plasticizer production reached an all-time high, with a 25% increase over 1958. The preliminary United States Tariff Commission report indicates production of 524 million lb. in 1959 versus 418 million lb. in 1958, or a growth of 106 million pounds. Over 65% of the 1959 production (355 million lb.) were used in polyvinyl chloride and copolymers.

It was the rapid growth of these resins that was primarily responsible for the increased production and sales of plasticizers in 1959. Some of the increase is, however, the result of improved reporting techniques to the Tariff Commission. The remaining 169 million lb. include plasticizers for all other vinyl resins, cellulosics, rubber and miscellaneous plasticizer uses, plus additional applications such as gasoline additives, lubricants, and functional fluids.

This record was obtained in spite of the steel strike in the last half of 1959 which drastically curtailed the availability of naphthalene, the essential raw material for phthalic anhydride. Since phthalic anhydride is the starting point for phthalate esters, this resulted in plasticizer shortages during the last part of the year which carried over into 1960. To augment the available naph- **(To page 162)**

*Monsanto Chemical Co., Organic Chemicals Div.

FIG. 1: Important end-use markets for plasticizers in polyvinyl chloride and copolymers, plotted for selected years. All numbers represent millions of pounds.



United States Production and Sales of Plasticizers[a]

Chemical	Production					Sales 1959		Unit value
	1950	1956	1957	1958	1959			
	1000 lb.	1000 lb.	1000 lb.	1000 lb.	1000 lb.	1000 lb.	$1000	per lb.
GRAND TOTAL	**243,318**	**416,788**	**442,206**	**417,944**	**523,969**	**461,889**	**137,665**	**$0.30**
PLASTICIZERS, CYCLIC								
Total	**180,631**	**315,343**	**329,290**	**312,225**	**395,934**	**354,750**	**96,538**	**0.27**
Phosphoric acid								
Tricresyl phosphate[c]	15,311	32,265	29,944	26,463	31,375	30,790	9,361	0.30
Triphenyl phosphate	6,212	8,318	8,991	8,023	8,427	—	—	—
Cresyl diphenyl phosphate	—	—	—	7,222	10,525	9,509	2,644	0.28
Phthalic anhydride esters, **total**	**142,582**	**237,382**	**251,271**	**237,464**	**299,235**	**268,883**	**69,213**	**0.26**
Butyl decyl phthalate	—	3,869	4,582	10,573	—	—	—	—
Dibutyl phthalate	19,788	22,017	17,702	12,902	15,130	11,652	3,143	0.27
Dicapryl phthalate	—	3,667	—	—	—	9,604	2,399	0.25
Dicyclohexyl phthalate	—	—	5,994	6,771	6,683	3,461	1,449	0.42
Diethyl phthalate	16,054	18,661	18,281	14,454	16,128	10,615	2,492	0.23
Diisodecyl phthalate	—	17,038	24,431	23,372	28,777	26,126	6,718	0.26
Di(methyl cellcsolve) phthalate	1,810	3,247	2,388	2,702	2,991	2,805	960	0.34
Dimethyl phthalate	3,767	4,037	3,293	3,494	3,318	3,582	850	0.24
Dioctyl phthalates, **total**	—	**111,661**	**113,095**	**110,840**	**146,788**	**126,443**	**31,313**	**0.25**
Di(2 ethyl hexyl) phthalate	60,537	80,632	73,568	76,729	104,811	86,981	21,638	0.25
Diisooctyl, di-n-octyl, & mixed octyl phthalates	2,595	31,029	39,527	34,111	41,977	39,462	9,675	0.25
Octyl decyl phthalate, **total**	—	**11,269**	**13,319**	**10,293**	**20,466**	**21,015**	**5,332**	**0.25**
n-octyl n-decyl phthalate	—	—	—	—	10,291	10,136	2,705	0.27
iso-octyl iso-decyl phthalate	—	—	—	—	4,772	5,783	1,368	0.24
all other	—	—	—	—	5,453	5,096	1,259	0.25
All other[d]	38,031	41,916	48,236	42,063	58,954	53,580	14,557	0.27
All other cyclic plasticizers[e]	16,526	37,378	39,084	33,053	46,372	45,568	15,320	0.34
PLASTICIZERS, ACYCLIC **Total**	**62,687**	**101,455**	**112,916**	**105,719**	**128,035**	**107,139**	**41,127**	**0.38**
Adipic acid esters, **total**	**5,965**	**8,504**	**8,982**	**9,459**	**13,769**	**11,038**	**4,641**	**0.42**
Diisodecyl adipate	—	1,150	1,294	1,963	2,989	3,055	1,209	0.40
Di(2-ethyl hexyl) adipate	1,975	1,128	1,828	1,731	1,726	1,702	675	0.40
Octyl-decyl adipate	—	—	—	1,137	1,770	1,506	569	0.38
Diisobutyl adipate	—	—	359	—	—	—	—	—
Complex adipic acid polyesters	—	—	—	—	3,068	2,310	1,181	0.51
Diisooctyl adipate	1,206	2,218	1,833	2,134	3,561	1,952	742	0.38
All other	2,784	4,008	3,668	2,494	3,723	2,823	1,446	0.51
Azelaic acid esters, **total**	—	**9,474**	**5,654**	**6,160**	**8,078**	**6,744**	**3,060**	**0.45**
Di (2-ethyl hexyl) azelate	—	—	—	—	7,091	6,539	2,954	0.45
All other	—	—	—	—	987	205	106	0.52
Glyceryl monoricinoleate	—	301	334	328	430	436	152	0.35
Oleic acid esters, **total**	**7,401**	**10,084**	**10,033**	**6,007**	**7,309**	**5,018**	**1,402**	**0.28**
Butyl oleate	—	1,858	2,006	1,179	2,101	686	154	0.22
Methyl oleate	—	693	817	—	948	—	—	—
All other	—	7,533	7,210	4,828	4,260	4,332	1,248	0.29
Palmitic acid esters	—	—	—	2,606	2,904	889	232	0.26
Phosphoric acid esters	4,887	6,565	10,221	7,327	8,231	7,206	2,987	0.41
Sebacic acid esters, **total**	2,258	11,702	12,533	11,635	9,969	6,593	3,908	0.59
Dibutyl sebacate	2,258	3,111	3,595	—	3,993	1,251	807	0.64
All other	—	8,591	8,958	—	5,976	5,342	3,101	0.58
Stearic acid esters, **total**	**17,158**	**10,586**	**9,903**	**5,648**	**7,677**	**5,937**	**1,526**	**0.26**
n-butyl stearate	1,904	7,085	5,892	2,426	4,118	3,444	810	0.24
All other	15,254	3,501	4,011	3,222	3,559	2,493	716	0.29
Triethylene glycol di (caprylate-caprate)	—	1,440	2,315	1,659	2,688	2,541	911	0.36
All other acyclic plasticizers[f]	25,018	42,789	52,721	54,890	66,980	60,737	22,308	0.37

[a] All figures are from U. S. Tariff Commission Reports.
[b] Calculated on rounded figures.
[c] Includes material produced for use as motor fuel additive.
[d] Includes data for phthalic anhydride esters of phenol, cyclohexanol, fatty alcohols, mono & di-hydric alcohols, cellosolves, & phthallyl glycollates.
[e] Includes data for synthetic camphor, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.
[f] Includes data for citric and acetylcitric, palmitic, tartaric and ricinoleic acid esters, and for butyl myristate; glyceryl and glycol esters of certain fatty acids, glyceryl tripropionate, complex polymeric materials and other acyclic plasticizers.

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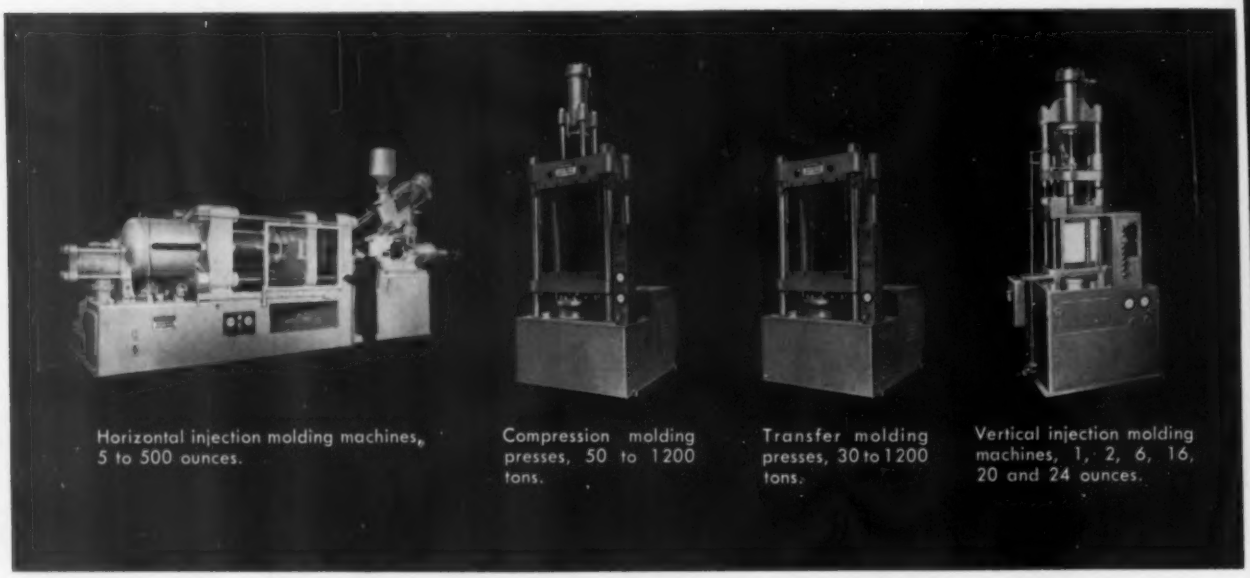

Horizontal injection molding machines, 5 to 500 ounces.

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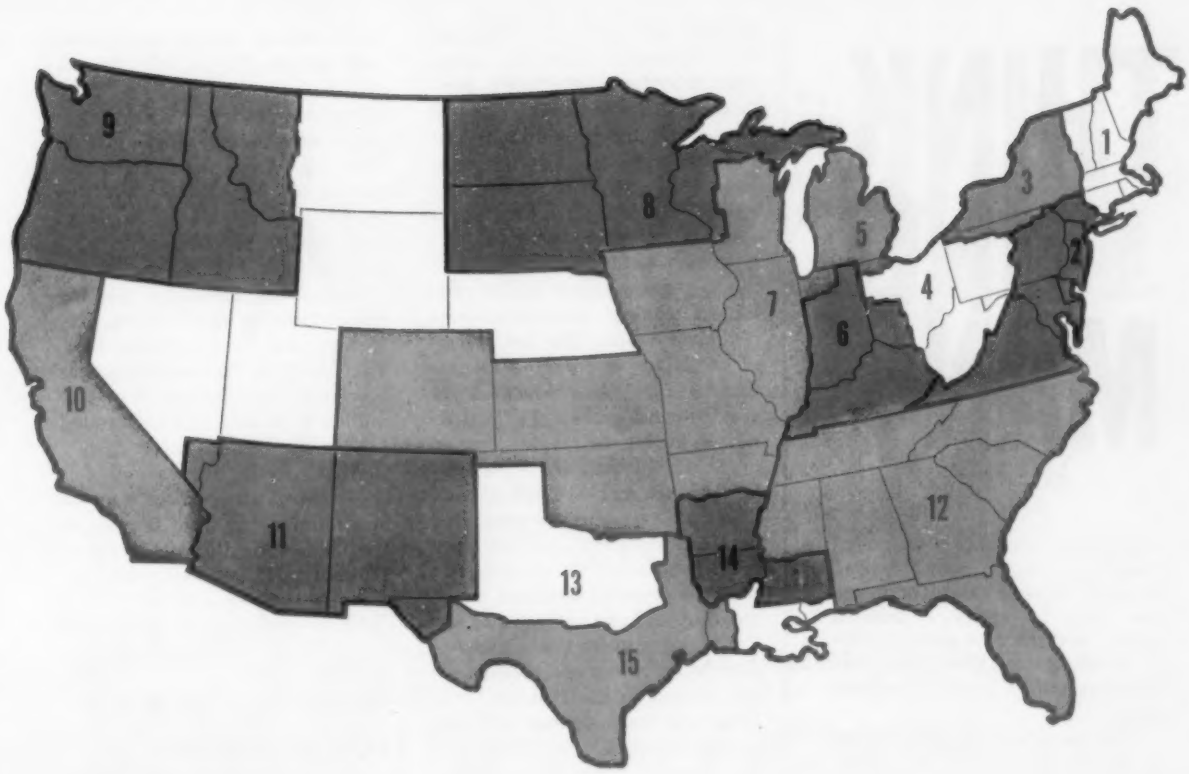
Vertical injection molding machines, 1, 2, 6, 16, 20 and 24 ounces.

FARREL WATSON-STILLMAN MOLDING

WS-76



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You can buy mold releases for as little as fifteen or twenty cents a pound. Bomb-Lube costs much more, yet is used by more molders than all other releases combined. Why? Because it's cheapest to use!

This premium quality, patented formula mold release will not mark or discolor the part, will not build up on the mold.

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thalene, some producers utilized ortho-xylene as a starting material. As a direct result of the prolonged steel strike, several oil companies upped plans for petroleum naphthalene. It probably will be late 1961 before material is available from this source.

Plasticizer prices (which always have been extremely competitive) reached a new low in 1959 for the largest volume plasticizers—the phthalate esters. The low prices of phthalate esters in 1959 plus the reduced selling schedules for vinyl resins caused PVC compounds to hit their lowest prices in history. Thus, new and expanded uses for polyvinyl chloride developed. Among the expanded uses for polyvinyl chloride were greatly increased consumption in the floor covering field and in the molding and extrusion category.

To further make 1959 a memorable year, Congress passed the amendment to the Federal Food, Drug and Cosmetic Act to be effective March 6, 1960. While this had a rather minor effect on formulations in 1959, the year 1960 will see a great many formulation changes to comply with the Act resulting in additional sales of non-toxic plasticizers.

A decade of growth

Plasticizers have had an average annual growth of 7.7% for the past 10 years. This is shown in Table I, below.

Table II, p. 164, shows the estimated use of plasticizers in resins for 1950 and 1959. It will be noted that the major growth of plasticizers in this decade has been in the plasticization of polyvinyl chloride and its copolymers (135 million lb. in 1950 to 355 million lb. in 1959).

The important end markets for plasticizers in polyvinyl chloride and copolymers are shown in greater detail in Table III, p. 164. Figure 1, p. 158, shows the same data plotted for selected years. It will be noted that the major growth areas for vinyl chloride resins includes the molding, extrusion, and floor covering field. The growth in floor coverings has been truly outstanding—from 21.9 million lb. in 1953 to an estimated 157.0 million lb. in 1959.

What is the future for this field? When one realizes that the maximum upper limit for use in the field—estimated to be 150 to 175 million lb. annually—was essentially reached in 1959, it is difficult to predict the future. Best current estimates are, however, that 225 million lb. are probably the upper limit of growth by 1965.

Types of plasticizers

The U. S. Tariff Commission report divides plasticizers into two major classifications: cyclic and acyclic. The cyclic classification includes any containing an aromatic (benzene) nucleus.

Acyclic products are aliphatic compounds of two main types. The first is based on dialkyl esters of aliphatic dibasic acids, while the second is derived from fats, vegetable oils, and other naturally-occurring products.

Cyclic plasticizers

Phthalic anhydride esters: Phthalate esters continue to dominate the plasticizer field. They

Table I: Growth of plasticizers since 1950

Year	Production millions of lb.	Growth over preceding year millions of lb.	Growth over preceding year %
1950	242	—	—
1951	280	38	15.7
1952	266	— 14	— 5.0
1953	292	26	9.8
1954	300	8	2.7
1955	395	95	31.6
1956	416	21	5.3
1957	442	26	6.3
1958	418	— 24	— 5.4
1959	524	106	25.4

NUODEX Announces

FUNGITROL® 11

a non-metallic . . . heat-stable . . .

safe-to-use . . . non-staining

FUNGICIDE

for calendering

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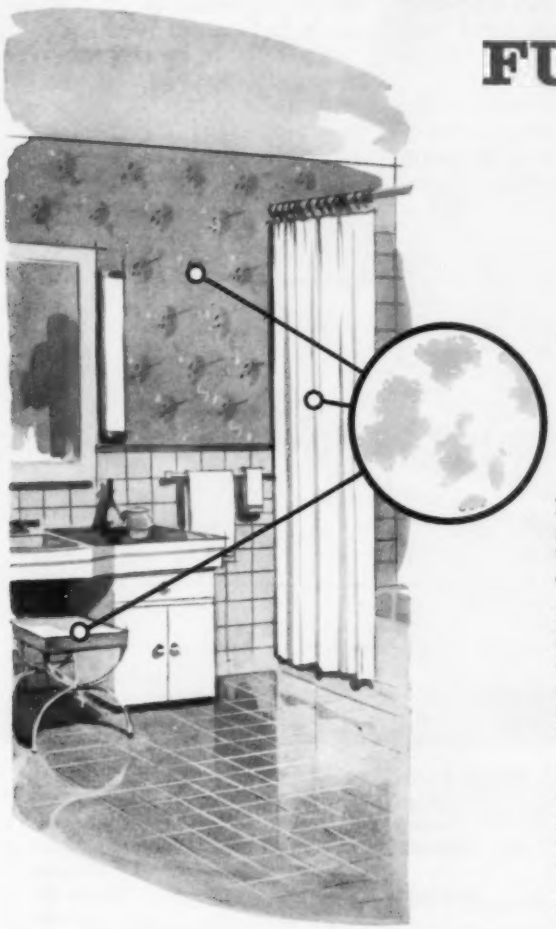

Nuodex announces another new advance in its program to help producers of vinyl calendered and extruded materials to improve their products at lower cost—Fungitrol 11.

Fungitrol 11, a fungicide-bactericide, delivers a higher level of long-lasting activity than other chemicals now available. Concentrations can be reduced by as much as 50% or more to achieve equivalent protection against "pinking" and other attacks caused by fungus. Fungitrol 11 also controls a wide spectrum of bacteria.

Fungitrol 11 offers important advantages in processing. It is both heat- and light-stable, has a color superior to other fungicides, is non-staining, has low residual odor, holds side effects to minimum. It is non-metallic, non-toxic, non-irritating and, because of its extremely neutral nature, is safe for use in various types of wearing apparel.

For complete technical data, including recommended levels of concentration, and a sample of Fungitrol 11, write to Nuodex, Plastics Products Division.

NUODEX special purpose chemicals for industry

NUODEX PRODUCTS COMPANY • ELIZABETH, NEW JERSEY

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account for 299 million lb. of the 524 million produced, or roughly 57 percent. This percentage has remained relatively constant over the past decade.

The steel strike resulted in the previously-mentioned shortage of phthalate esters during the last half of 1959. The formulating chemist showed great ingenuity in substituting materials not seriously affected by the steel strike, such as phosphates, adipates, benzoates, polymerics, and secondary plasticizers, in order to keep the consuming public adequately supplied with plastic articles. Since most of these substitutions resulted in slightly increased costs, they will not result in a permanent loss of markets for phthalate esters. The shortage of phthalic anhydride probably reduced total phthalate ester production by at least 10 million lb. in 1959.

Approximately 230 million lb., or 72%, of the total phthalates are estimated to be used in vinyl chloride resins. Dioctyl phthalates continue to dominate the phthalate ester market, although octyl decyl phthalates and diisodecyl phthalates are being used in many new applications.

Dioctyl phthalate types increased by 36 million lb. over 1958 because of their general purpose properties. Octyl decyl phthalates increased 10 to 20 million lb., while diisodecyl phthalate showed a growth of over 20 percent.

All other phthalate esters grew by 17 million lb., the bulk of which (11 million lb.) is probably butyl octyl phthalate, which is reported separately in 1958 but not in 1959.

In the lower-molecular-weight phthalate esters, dibutyl phthalate showed a 2 million lb. growth over 1958, not because of any new technology but primarily because of increased demand due to improved business conditions.

Dimethyl phthalate showed a slight decrease in 1959 compared to 1958. In all probability, a portion of this was replaced by diethyl phthalate in cellulose acetate because of the latter's approval by the FDA. Consequently, diethyl phthalate showed an increase over 1958 with further increases expected in 1960 as it replaces a portion of the dibutyl phthalate used in adhesives.

Phosphoric acid esters: Tricresyl phosphate showed a growth of almost 20% in 1959 over 1958, the major portion of which was due to its increased use as a gasoline additive. Of the 31 million lb. produced in 1959, it is estimated that only 15 to 17 million lb. were used as true plasticizers, with the balance being used as lubricants, hydraulics, or gasoline additives. Tricresyl phosphate remains one

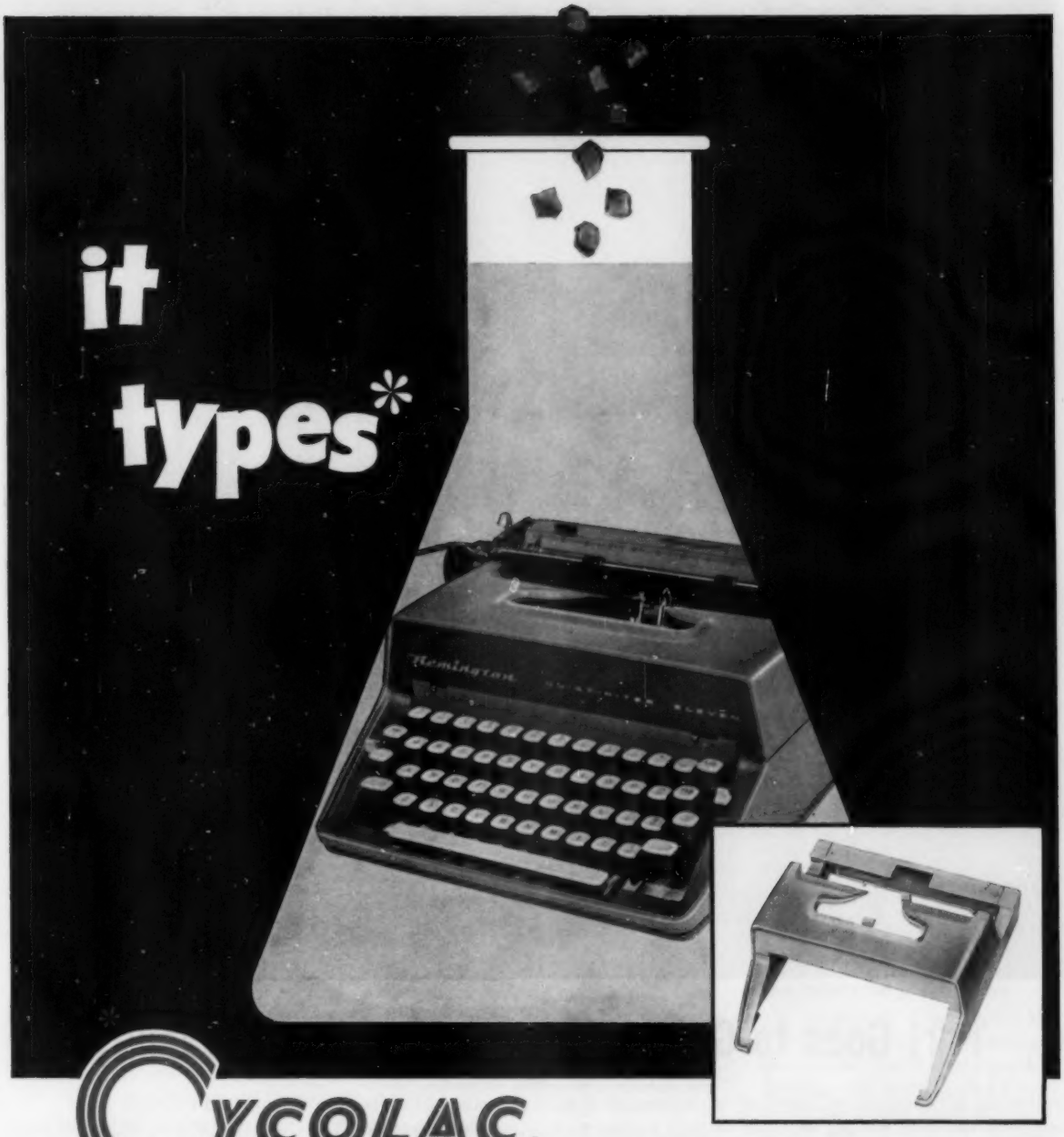
Table II: End-resin use of plasticizers

Estimated resin	*1950*		*1959*	
	lb.	*%*	*lb.*	*%*
PVC and copolymers	135,000,000	55.9	355,000,000	67.8
Other vinyls	15,000,000	6.2	51,000,000	9.7
Cellulosic resins	50,000,000	20.6	45,000,000	8.6
Rubber	9,000,000	3.7	22,000,000	4.2
Other resins and non-plasticizer/resin combination uses	33,000,000	13.6	51,000,000	9.7
Total	**242,000,000**	**100.0**	**524,000,000**	**100.0**

Table III: Plasticizer use in PVC end applications

Use	*1950*		*1959*	
	Resin[b]	*Plasticizer*	*Resin*[a]	*Plasticizer*
Film under 10 mils	81,000,000	32,400,000	86,000,000	34,000,000
Sheeting 10 mils and over	64,000,000	35,200,000	87,000,000	47,000,000
Fabric treatment	35,000,000	17,500,000	70,000,000	35,000,000
Paper treatment	7,500,000	2,600,000	10,000,000	3,000,000
Floor coverings	—	—	157,000,000	58,000,000
Molding and extrusion	68,000,000	33,000,000	290,000,000	136,000,000
Phonograph records	10,000,000	—	43,000,000	1,000,000
Slush and elastomeric molding	1,000,000	1,000,000	54,000,000	43,000,000
Profiles	3,000,000	1,000,000	46,000,000	20,000,000
Wire coating	45,000,000	27,000,000	96,000,000	57,000,000
Rigid pipe and shapes	—	—	18,000,000	—
Garden hose	9,000,000	4,000,000	24,000,000	10,000,000
Miscellaneous	—	—	5,000,000	2,000,000
Foam and sponge	—	—	4,000,000	3,000,000
Protective coatings	—	—	31,000,000	3,000,000
All other uses	35,000,000	14,300,000	97,000,000	39,000,000
Total	**290,500,000**	**135,000,000**	**828,000,000**	**355,000,000**

[a] c.f. MODERN PLASTICS, Jan., 1960, pp. 97-98.
[b] c.f. MODERN PLASTICS, Jan., 1953, p. 62.



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Part Goes to Grace Plastic for Greater Durability

Automatic Milk Service, Inc. improved the performance of its coin operated milk vending machines through a change in design and material for one key part. The part is a chute through which milk cartons are dispensed. Produced the new way, it rarely requires repairs or maintenance.

The chute is subjected to rugged treatment every time the machine is operated (a carton of milk is released from above and hits the chute with considerable impact), and every time the machine is filled (the serviceman uses the chute as a platform to hold his milk case). Many different materials were tested for the part. Grace's high density polyethylene was chosen as the material that could withstand such abuse over a long period. The chute was redesigned for efficient vacuum forming with Grex sheet by Highland Products, Inc.

Chutes made from this Grace plastic stand up so well they rarely require attention. Even in cold weather, when other plastic materials lose their strength, these Grex chutes will not crack or break on impact.

For the vending machine company the use of Grex means longer chute life and lower maintenance costs. Perhaps you can reduce costs, too, by taking advantage of Grex for your products. The best way to find out is by calling in the experts. Grace has the production, technical and marketing facilities to help put your product in the Grex profit parade. Everyone says we're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

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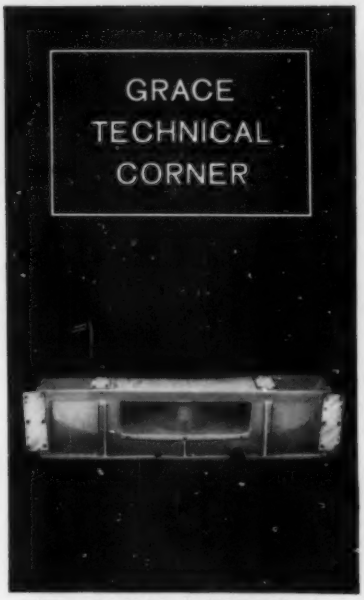

Large part designed with deep draws successfully vacuum formed from Grex sheet.

The experience of Highland Products, Inc. in redesigning and forming the chute for milk dispensing machines may give you some ideas on how to take maximum advantage of Grex for your *own* projects.

Simplification in design was the first step in production of the part. Originally it was a complicated assembly of nearly twenty pieces. The new design by Highland calls for only two large vacuum formed Grex pieces plus three flat Grex strips as stiffening members.

Deep draw required. In the interests of production efficiency and part performance, Highland's design calls for deep draws, straight walls and sharp corners. Such design requirements are difficult to satisfy in thermoforming many types of plastic sheet. The fact that satisfactory parts are being produced may be attributed to the thermoforming characteristics of high density polyethylene.

Slow cooling an advantage. High density polyethylene remains workable for a relatively long period. In this case, the Grex sheet is workable for 60 to 90 seconds after drawdown—sufficient time to obtain necessary detail on the sides of the pieces.

Want to know more about what can be accomplished by vacuum forming of Grex sheet? If you have an application in mind, give Grace Technical Service the opportunity to help you. We may not know all the answers, but we do have experience with high density polyethylene on our side—and are learning more every day.

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of the most permanent monomeric plasticizers and is well established as a flame-retarding plasticizer for polyvinyl chloride as well as for cellulosic resins.

Triphenyl phosphate remained essentially static in 1959 with its main use continuing as a flame-retarding plasticizer for cellulose acetate resins when used in combination with low-molecular-weight phthalate esters.

Cresyl diphenyl phosphate showed a growth of 3 million lb. primarily as a gasoline additive.

All other cyclic plasticizers: All other cyclic plasticizers showed a growth of 13 million lb. in 1959 following the industry growth pattern, and also benefiting from some temporary replacement of phthalate esters because of their shortage. This category includes other aromatic phosphates, toluenesulfonamide plasticizers, chlorinated biphenyls and terphenyls, synthetic camphor, tetrahydrofurfuryl oleate, and others.

Acyclic plasticizers

Adipic acid esters: Adipic acid esters showed a growth of 4.3 million lb. in 1959. For the first time complex adipic acid polyesters are shown in this category at 3 million pounds. This figure seems extremely low and undoubtedly a much greater percentage of complex polyesters containing adipic acid are shown under the "all other" acyclic category. The dialkyl adipic acid esters find their main use as special plasticizers to impart good low-temperature flexibility to vinyl chloride resins, rubber, and miscellaneous resinous compounds.

Azelaic acid esters: Azelaic acid esters (the major portion of which is di-2-ethyl hexyl azelate) showed an increase of 2 million lb. in 1959. They are used primarily as a flexibilizing plasticizer in vinyl films and coated fabric plus uses in the lubricant field.

Phosphoric acid esters: The production of acyclic phosphoric acid esters increased by roughly 1 million pounds. Tri-2-ethyl hexyl phosphate is perhaps the largest single plasticizer in this category. It is used primarily in applications as a low temperature, fungus-resistant plasticizer for vinyl coatings. Tributyl phosphate also makes up a large portion of the acyclic phosphoric acid esters, being used in a non-plasticizer application. Tributoxy ethyl phosphate is most widely used in polystyrene floor wax systems.

Sebacic acid esters: Sebacic acid esters declined by almost 2 million lb. in 1959. This decline was predictable on the basis of increased competition from azelate and adipate acid esters in both the plasticizer and lubricant field.

Stearic acid esters: Stearic acid esters showed a 2 million lb. increase with the bulk of the growth in butyl stearate. Butyl stearate is used primarily in rubber applications. It is possible that the sales of epoxidized stearates are shown partially under the stearic acid ester column and also partially estimated under the all other acyclic category.

Polymeric plasticizers: All other acyclic plasticizers increased from 51 million lb. in 1958 to 67 million lb. in 1959. This is one-half of the acyclic plasticizers produced, making it difficult to make a detailed analysis of this figure. If one assumes that this includes a major portion of the polymeric plasticizers consumed, plus the epoxidized fatty acid esters and triglycerides, such a total could be accounted for. It is estimated that of this 67 million lb., over 30 million lb. was the polymeric plasticizer type, with well over another 30 million lb. being of the epoxy type ester.

The future of plasticizers

It is difficult to anticipate the future pattern of plasticizer requirements. As new applications develop, new demands are placed on the plasticizer manufacturer to supply specific products to meet these applications. However, it is safe to say that the standard plasticizers will undoubtedly continue to expand in growth as new vinyl applications are developed, but their growth will be supplemented with specialty plasticizers to meet end product requirements. The greatest activity is occurring in the areas of developing more permanent monomeric phthalates, improved polymeric plasticizers and increased emphasis on additional and different plasticizers for non-toxic applications.—**End**

NEW DEVELOPMENTS

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.

Magnetic vinyl for level

Designed for electricians, plumbers, metal workers, and construction personnel, new levels make use of recently developed magnetized vinyl strip to free both hands of the user.

The levels were developed by Empire Level Mfg. Co., Milwaukee, Wis., and incorporate flexible Koroseal magnetic strip supplied by B. F. Goodrich Industrial Products Co., Akron, Ohio. The new tool constitutes a valuable time saver because it clings to metal surfaces and gives a constant and accurate reading while workers can use both hands for fitting and leveling.

This is the third major application for magnetized vinyl strip. Initial volume use for the new product was an airtight strip to seal refrigerator doors. The second one, introduced earlier this year, involved the adaptation of the flexible magnet to storm and screen doors that "remember to shut themselves."

Better bowling ball bags—for 25% less

LIGHT WEIGHT and indestructibility are two of the prime reasons why ABS sheet material is used by Regal Plastic Co. to produce this bowling ball bag.

After scoring handsomely in luggage, ABS (acrylonitrile-butadiene-styrene) sheet material has now penetrated another, though related, field: bowling ball bags.

Considering the abuse such bags get, the frequency with which they are used, and the fact that a bowling ball weighs around 16 lb., it is clear that any material that wants to compete in this lucrative market (there are close to 30 million bowlers in the United States) must not only be tough; it has to be practically indestructible. What's more, it must combine this indestructibility with light weight, so it doesn't contribute unnecessary poundage to the already heavy burden of the bowler. Finally, these bags must be competitive in price.

A line of bowling bags, developed by Regal Plastic Co., Kansas City, Mo., meets all the requirements. Not only does it weigh less than comparable leather bags, but the retail price is $14.95, roughly 25% below other high-quality equivalents. Being made of ABS sheet, the bag is stain-, water-, mildew-, grease-, shatter-, and fractureproof. It comes in white, blue, saddle tan, charcoal gray, red, and black.

The carrier is blow formed in two halves of ⅛-in.-thick-Royalite 400 Series ABS sheet material, a product of U. S. Rubber Co., Naugatuck, Conn. Forming is into a grained female cavity, run on a Regal sheet-forming machine. Both male and female shells incorporate Regal-patented (U. S. 2,878,907) turned-in edge construction, which eliminates the necessity of any type of male and female attachments for the closures. A separate cavity is used for each shell.

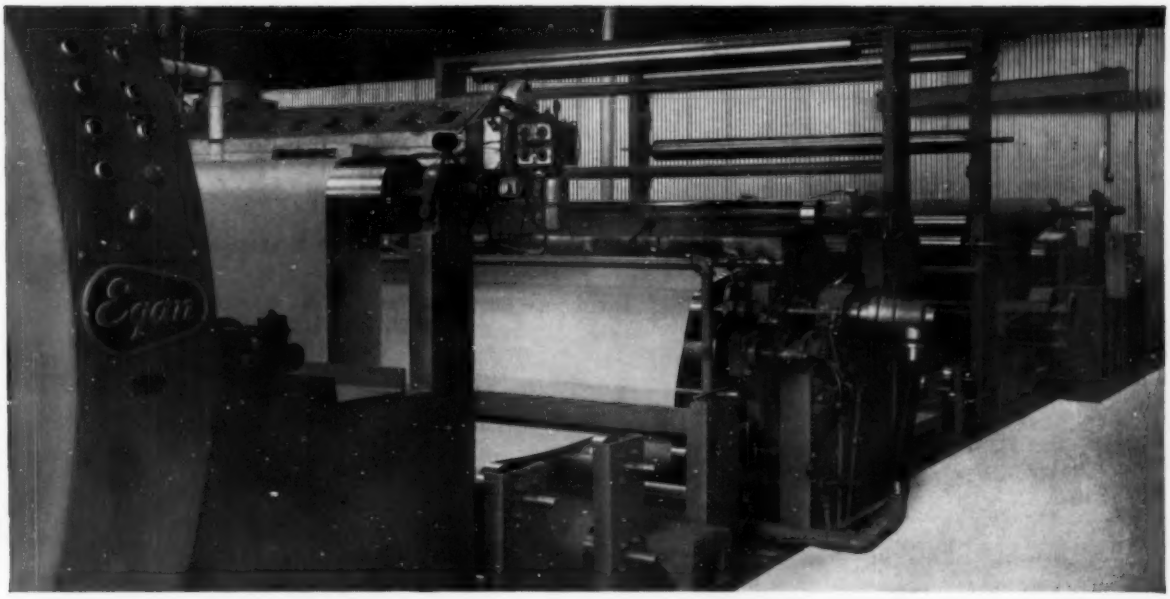
The bottom is reinforced with a separately formed cup of ⅛-in. Royalite that also provides the depression into which the bowling ball fits. In addition, the cup moves the ball automatically up into a lift-out position when the bag is opened.

A special formed insert, produced of ABS-strip, forms a compartment at the top of each shell to hold a bowling shoe. The insert is attached to the shell with a specially developed adhesive.

Handles are molded of high-density polyethylene. Draw bolt, hinge stays, and other hardware are attached with tubular rivets, backed up with washers, etc., on the interior of the ABS shell.

According to Regal, Royalite was chosen because it is available as solid colored sheet, has low-temperature impact resistance down to −60° F. (much bowling is done in the winter), has a deformation temperature up to 185° F. under load, and, perhaps most important of all, has been used with considerable success in the company's line of Regal-Aire luggage.

Sale of the bag is brisk, according to the company. It suggests that the field of small specialized carriers (from doctor's bags to lunch pails) is one the plastics in- **(To page 172)**



FOR HIGH-SPEED POLYETHYLENE COATING OF WIDE PAPER

CONTINUOUS OPERATION AT 1,000 FPM

When the converting operation calls for polyethylene coating of wide-web kraft and other papers, no production unit can surpass an Egan Extrusion Coater!

The coater illustrated above includes a flying-splice unwind stand, direct electric heat extruder, die, laminator, and single drum surface winder. The combination is capable of continuous operation at 1,000 fpm.

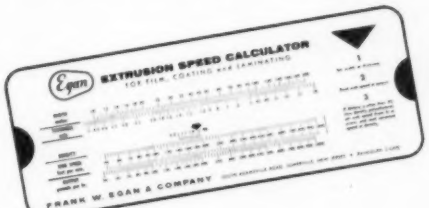
Open construction of the laminating unit permits maximum access and visibility for the operators. The laminator also has controlled stripping tension, and includes *patented* horizontal and vertical adjustments of the laminating nip which are essential for maximum adhesion control.

The cooling roll is of a unique *patented* design. This double spiral roll provides for highly efficient cooling and extremely uniform temperatures across the roll. Use of the double spiral permits water to enter simultaneously from both ends of the roll and exit at opposite ends from the point of entry. The temperature across the entire face of the roll during operation has a differential of no more than 2°F.

Egan production units are available in widths to 120″.

WORLD'S LEADING MANUFACTURER OF EXTRUSION COATERS

WRITE for this handy Egan Extrusion Speed Calculator which quickly determines any extrusion capacity required for a specific web speed, width, and coating thickness.



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SOMERVILLE, NEW JERSEY

CABLE ADDRESS: EGANCO—SOMERVILLE, N.J.U.S.

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GREEN PEAS
WT. 1 LB. 4 OZS.
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WESTPAC
Shelled at the Plant
GREEN PEAS
2 FULL POUNDS
KEEP FROZEN
2 LBS. NET WT.
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Quick Frozen
GREEN PEAS
CONTAINS SLIGHT AMOUNT OF SALT
2 lbs.
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Stokely's
Finest
POUR AND S
GOLD
SWEET
2 FULL POUNDS
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Golden Sweet Whole Kernel
CORN
A
FANCY
2 FULL POUNDS
KEEP FROZEN
2
LBS. NET
WEIGHT
U.S. GRADE "A" FANCY
Libby's
SWEET
PEAS
KEEP FROZEN
ECONOMY PACKAGE
NET WEIGHT 1 LB. 8 OZ
EACH KERNEL INDIVIDUALLY FROZEN
POUR OUT WHAT YOU NEED
STORE THE REST
Bel-air
Premium Quality
Whole Kernel
2 LBS. NET WT.
golden corn

Frozen foods now go to market bagged in film of **TENITE POLYETHYLENE**

Pollock Paper Company, *division of St. Regis Paper Co., using Tenite Polyethylene, supplies bags like these to package individually quick frozen foods — a new development that's spurring frozen food sales.*

Transparent packaging of individually quick frozen food—known to the trade as IQF—is a giant step forward in frozen food merchandising.

IQF foods are not frozen into a solid block. Instead, each piece is individually frozen *before* packaging. Thus, housewives can buy IQF packages (usually one and one-half to two pounds) and pour out just the amount needed for a meal. Retailers benefit through larger unit sales; processors, through the economy of a simpler packaging operation.

Bags were chosen for IQF foods so that the user would have the convenience of a package that could be reduced in size as the contents were consumed. For the bag material, processors turned to film of Tenite Polyethylene. This Eastman plastic has proved ideally suited to the demands of the job.

The film is strong, tough and flexible, and retains these qualities at below-freezing temperatures. Its performance on automatic filling machines reduces operating problems to a minimum. Strong seals, obtained with low sealing temperatures, increase package durability in shipment and in self-service cabinets.

Extruded on special equipment to assure accurate control of thickness, the film is supplied by Pollock in both bag and roll form to leading frozen food processors. These users report that it cuts costs by making possible unusually efficient machine operation with fewer broken bags.

Tenite Polyethylene is a versatile plastic. For more information on any use, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE®
POLYETHYLENE
an Eastman plastic

Film for frozen food bags extruded from Tenite Polyethylene by Pollock Paper Company; general offices, Dallas, Texas. Plants and sales offices located coast to coast.

(From page 168)

dustry might pursue. And in ABS sheet material and in vacuum forming it has both the material and the technique to do it.

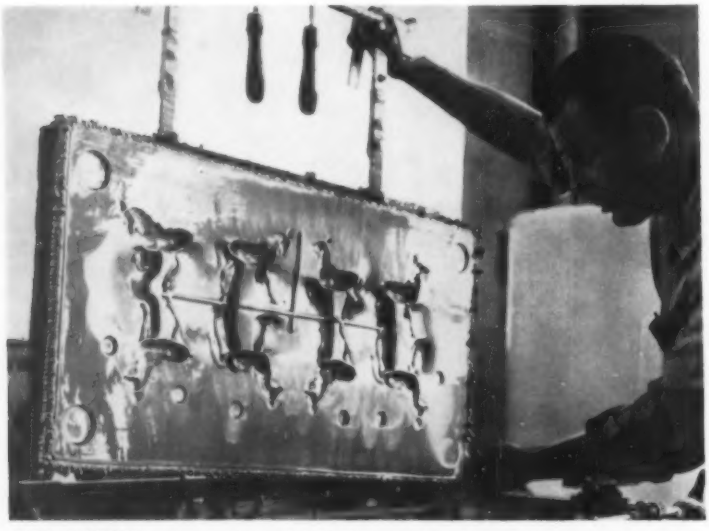
Special techniques for faster, simpler production

Electroformed molds and a 70-station decorating operation have helped make Hartland Plastics Inc., Hartland, Wis., one of the leading injection molders of figurines for use as toys, religious articles, or as point of purchase advertising aids. In these markets, where product life is short, the ability to rapidly convert a product idea into a production reality is mandatory. Aware of this, Hartland has, for 25 years, been constantly reshaping its manufacturing technique. The result is that today they can produce and market a complex, completely decorated item, such as the sheriff in the photo illustration, 120 days from the birth of the idea.

ELECTROFORMED MOLDS are favored for the production of the Matt Dillon (TV Western Star) miniature because of their ability to accurately and faithfully reproduce details.

This is impressive when one considers what is involved: A battery of artists, ready to work in any medium, sculpt and carve the master model; precision pattern makers take the fragile master and convert it into a model of wood or metal; a mold engineer breaks it down into moldable components and plans the mold layout and construction; the wax master cavities are then made for the production of electroformed molds in the electroplating baths illustrated below; finally the thin copper cavities are backed up with die metal, mounted in steel die frames, and the product is ready to be injection molded, decorated, packed, and shipped.

Electroformed molds play a large factor in the speed with which this can be done. Although the company has learned that on long runs these molds cannot hold exacting tolerances, and that maintenance becomes a problem, the pluses more than outweigh the minuses. With these molds, intricate, highly detailed cavities are quickly and faithfully produced, at a much lower cost than machined steel or cast beryllium molds. In molding figurines, accuracy is a must, especially in statues which are meant to imitate real-life characters. Kids today are sharp and a plastic reproduction of Matt Dillon must look like Matt Dillon to sell at the toy counter.



WAX MASTER of electroformed injection mold cavities shown emerging from the copper electroplating bath. The electroformed shell will be backed up with die metal and mounted in a steel frame for use in the injection machine.

The parts are molded on conventional HPM presses ranging from 9 oz. to 20-oz. units with an 80-oz. preplasticator. Component statuette parts, mostly made of cellulose acetate and cellulose acetate butyrate (from Eastman Chemical Products Inc. and Celanese Corp.) are assembled on jigs and fixtures at the press using acetone as a solvent cement. Acetate is used because of its excellent moldability and ability to reproduce fine mold detail while, at the same time, being easy on the soft thermoformed cavities.

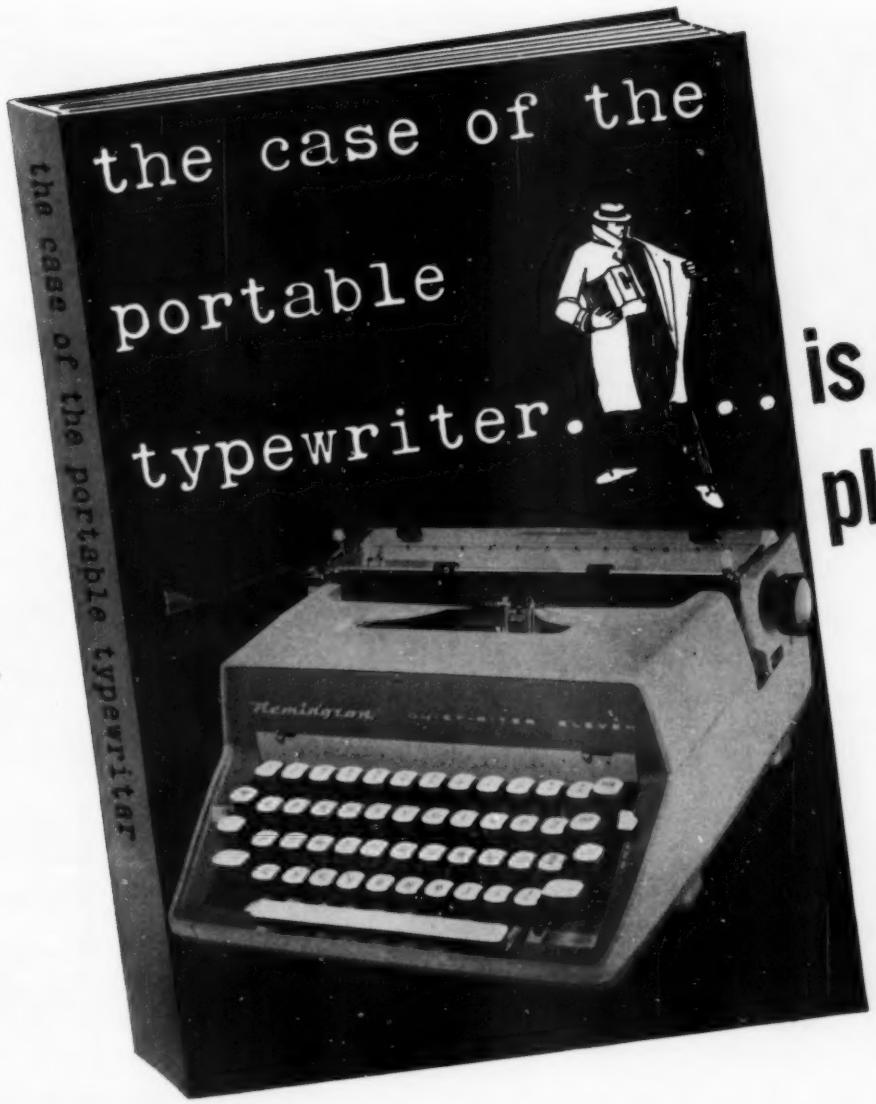
Another reason is its adaptability to spray painting and solvent cementing as well as its toughness in use. Butyrate is used where weather resistance is needed such as in the company's new line of 13- to 27-in.-high religious outdoor garden statuary, which is exposed to rain, hail, storms, etc.

Also contributing to the quality, efficiency, and the profitability of the figurine molding program is the layout and organization of the decorating department. Moving smoothly through the area on conveyor belts, the finished but unpainted statuettes are given their lifelike appearance through the application of as many as eight carefully formulated fast drying colors. (Bee Chemical Co., Chicago, Ill., and Wolverine Finishes Corp., Grand Rapids, Mich.) At 70 custom designed spray booths, the model is sprayed with each paint needed, using carefully fitted copper masks, to insure accurate delineation between different colors. Air brushes are used for special effects. At the end of the conveyor belt system, the parts are immediately packed and stored for shipment.

Hartland's program is of interest in that it shows what can be accomplished when a molder uses creative thinking in organizing his plant and selecting methods of manufacture tailored to the specific problems confronting his business.

All-purpose letter opener

A postal scale, letter opener, and magnifier all in one, composed of molded Lucite acrylic and Delrin acetal pieces, makes an attractive advertising give-away at **(To page 177)**



... is now all plastic

The assignment: "Track down a light, strong, attractive housing for a portable typewriter." It took two years of work by a whole force of highly-trained investigators before the case was finished, but the results paid off.

Many materials were checked out, but the solution to the problem was found in the use of plastic. It led to the development of a strong, smartly-designed, two-tone, all-plastic portable typewriter housing that is winning wide acclaim ... and sales. With over a million portables sold yearly, the sale of plastics takes another big step upward. And with the increasing use of plastics in building materials, appliances, furniture, luggage, automotive equipment and packaging, it's easy to understand the billion-pound growth of plastics last year (to a total of 5⅛ billion pounds).

Investigate this market! Your clue to extra sales lies in the fact that the processing of plastics requires machines, motors, tools, dies and a host of supplies and services for making, molding and finishing plastic products. And your best lead for capturing your share of the market lies in the use of MODERN PLASTICS ... the dominant magazine in the field, with more editorial matter, more paid subscribers and more advertising than all other plastics publications combined.

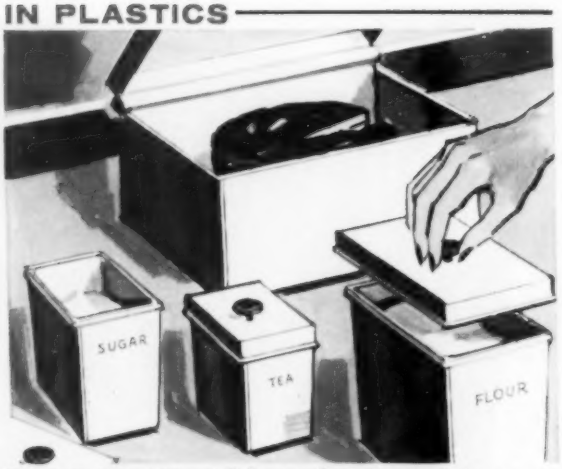
Get the Files. Write our nearest office for your copy of the MODERN PLASTICS Market and Media Data File.

MODERN PLASTICS

A Breskin Publication—Authority of the Field for 35 Years

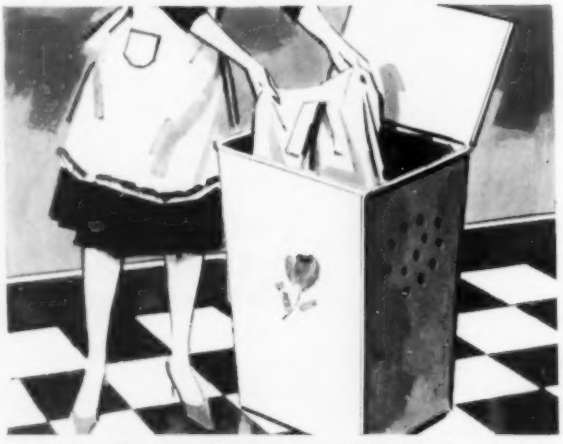
Offices: New York, 575 Madison Ave.; Cleveland, 3537 Lee Rd.; Chicago, 620 N. Michigan Ave.; Los Angeles, 6535 Wilshire Blvd.; Atlanta, 1722 Rhodes Haverty Bldg.

Beats the Heat! Housewares made of Escon get repeated use without warpage. That's because the heat resistance of polypropylene is greater than any other polyolefin. This makes it the desired material for such items as colanders, drainboards, dishpans, tumblers and lighting grilles.



Fresh Point of View! Polypropylene is 2 to 4 times more impermeable to gases and liquids than other thermoplastics. This means freshness stays in, outside elements can't enter. This makes Escon ideal for canister sets, bread boxes and cookie jars—which can be snap-fitted or self-hinged.

Cool Item! Escon is excellent as a food crisper for several reasons. It won't absorb strong food odors and, when properly molded, has the ability to take normal cold without cracking. The design possibilities with versatile Escon are limitless, providing the opportunity to expand existing markets.



New Idea! Escon can be undercut at high speed production cycles. Such items as clothes hampers can be molded in single flat pieces of various colors, then snap-locked for assembly and hinging. This means manufacturers can ship more products in less space . . . retailers will use less storage space, too.

Escon® POLYPROPYLENE CATCHES HER

Important news for molders and designers . . . Escon polypropylene is here! It's the amazing thermoplastic ideally suited to your product needs.

ENJAY
PLASTICS

Versatile Escon is easy to work with! It can be injection and compression molded, extruded, thermoformed and heat sealed. The injection molder can start at stock temperatures of 400-450°F., for small items . . . slightly higher for larger ones. In addition, gates and runners for Escon could be of the conventional type, and normal clamp pressures would be employed when molding it. And Escon molds easily—without warpage! Because of its low density, this amazing thermoplastic resin yields more pieces per pound.

EYE WITH NEW BEAUTY AND VERSATILITY

For the designer, the high strength of Escon plus its excellent chemical and abrasion resistance allows accurate production of fine and intricate designs with high surface gloss.

And because polypropylene offers greater heat resistance than any other polyolefin, products manufactured from Escon can be readily sterilized by heat or chemical means.

For technical assistance or to order Escon, contact the nearest Enjay office: (Home Office) 15 West 51st St., New York 19, N. Y. (Other Offices) Akron • Boston • Charlotte • Chicago • Detroit • Houston • Los Angeles • New Orleans • Tulsa.

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ENJAY CHEMICAL COMPANY

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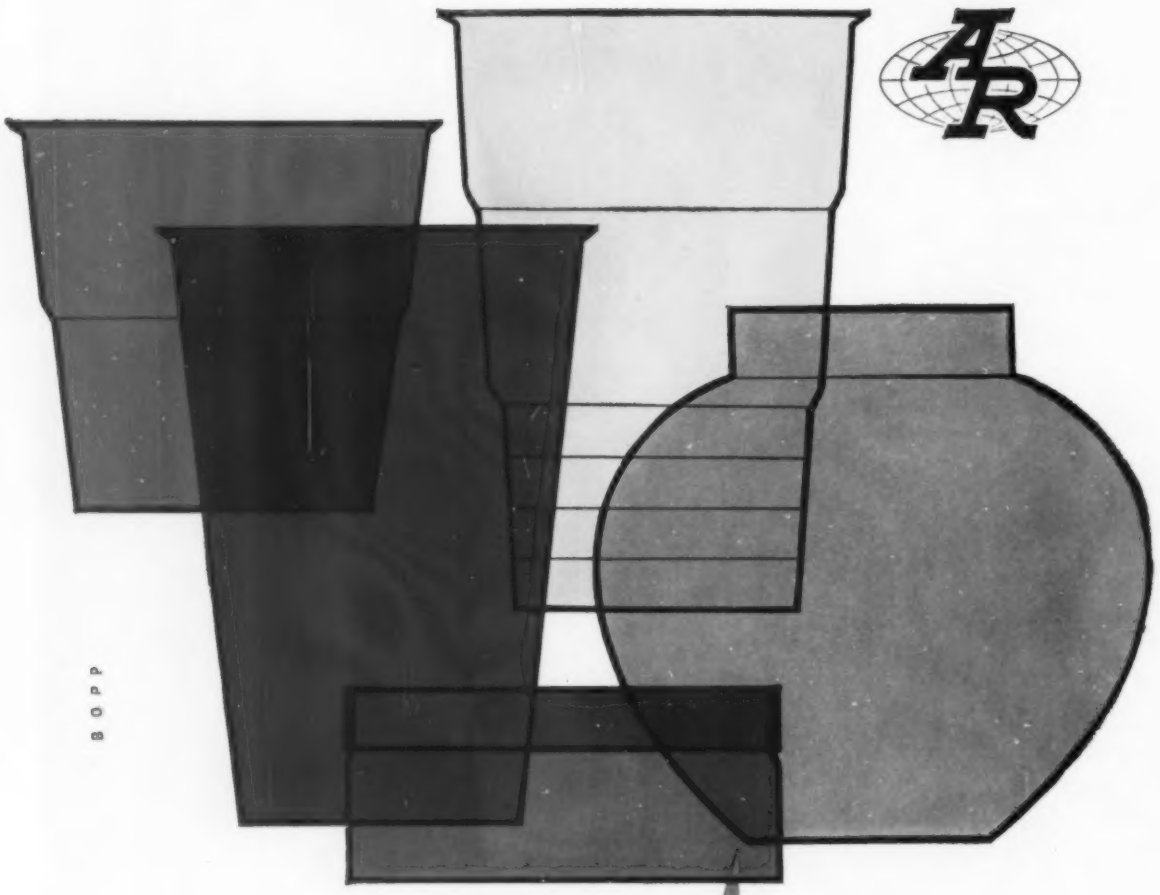

Cups and Containers straight from the Extruder

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in USA and Canada:

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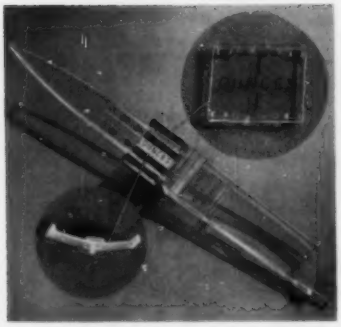


POSTAGE SCALE letter opener combination. Close-up of Delrin spring is at left; close-up of hot stamped window is at right.

Christmas. It is made up of four parts: the main body, about 10¼ in. long, consisting of a one-piece acrylic handle and blade; a plated powdered-metal slide weight; a 1-in. square acrylic "window," and a Delrin spring, 1 by ¼ in., that engages in a slot molded into the letter opener blade and provides an indexing stop at each end of the blade. Projecting lugs molded into the bottom center of the letter opener provide a pivoting point to make the unit a balancing scale. Letters to be weighed are placed on the handle, whose step-down design holds them in place. The blade of the instrument is calibrated in ½-oz. units. By moving the sliding weight along the blade, letter weight and postage requirements can be determined. As an additional bonus, the handle is designed to act as a magnifying lens, giving better than 2X magnification.

The unit, trademarked Stamp-Teller, is manufactured by Morgan Development Laboratories Inc., New Canaan, Conn. All parts are molded by Waterbury Companies Inc., Waterbury, Conn. The handle-blade combination is molded in a two-cavity mold on an 8-oz. Reed-Prentice, with the aspherical design lens formed by a separate insert. To assure proper curvatures of the lens and to keep calibrations accurate, parts are molded to a tolerance of ±0.002 inch. The window is produced in a two-cavity mold on a 4-oz. Reed-Prentice. The Delrin spring is made in a two-cavity mold in a 3-oz. Fellows. Legends and calibrations are hot stamped. It retails for $3 and can be imprinted as an advertising give-away.

Acetal for computer part

Acetal resin interposer links, key components in two models of Remington Rand Univac machines, are 80% less expensive and last 16 times longer than previously-used links of beryllium copper. The units, 315 to a machine, transmit impulses from punched cards to the electronic "brains" of the computer.

The plastic links are molded at a cost of $120 per thousand, compared to $630 for beryllium copper. And normal service life, 5 million cycles with the copper links, has now been increased to 80 million cycles with the acetal links.

In the past, particles of fretting corrosion from the copper links often caused bearing failure in nearby components. By switching to acetal resin, a material with good abrasion and frictional resistance, the manufacturer eliminated this problem. In addition, a single plastic link weighs just under 1 g., roughly seven times lighter than a copper link.

The interposer links are injection molded of Du Pont Delrin acetal resin by B & B Plastics, Oakville, Conn., which uses a seven-cavity mold on a 3-oz. Fellows machine.

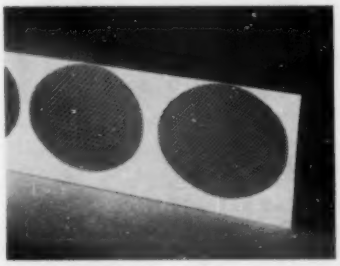
Metallized Mylar-vinyl laminate in die-cut strip

By supplying adhesive-backed, die cut pieces of metallized Mylar-vinyl laminate on continuous strips of heavy-weight backing paper, Coating Products Inc., Englewood, N. J., has brought new economies to the decorative production labeling of household equipment, product parts, business machines, product containers, etc. The new development has been designated Ready Strip.

Coating Products has been making such decorative laminations for some time under the tradename Mirro-Brite (the firm also produces a larger line of other film laminations). But until now the labor cost of applying single units by hand often exceeded the base cost of the decorative plastic material. Now, through the introduction of Ready Strip, hand labor is greatly eliminated. The strips can be run on automatic labeling equipment, according to the company.

The following shows how the strips are produced:

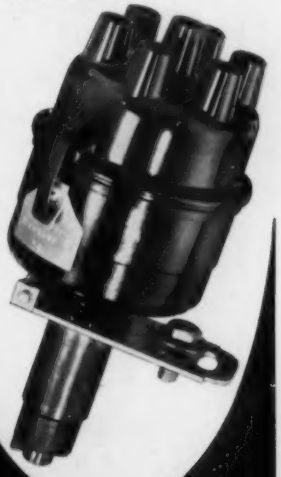
1. Clear rolls of Mylar (To page 178)



example...

FIBERITE

Reinforced phenolics at work...



for ELECTRIC AUTOLITE distributor bowls

Autolite needed a plastic molding compound for a new base molded around a powdered metal bearing insert for ignition distributors in automotive and industrial engines. The molded part must maintain rigid dimensional tolerances under very adverse conditions of temperature and humidity. Autolite specified Fiberite No. X-2414 cotton fiber reinforced phenolic. Here is Autolite's report:

1 Dimensionally stable
2 Impact resistant
3 Heat resistant
4 Corrosion resistant
5 Light weight
6 Easily machined

EXPLORE FIBERITE

If you need a reliable molding compound with excellent electrical and mechanical properties plus the best in resistance to shock, chemicals and heat, explore Fiberite.

We have formulations to fit a variety of applications. Our research department is at your disposal. Write for the Fiberite catalog.

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Colorful Beauty
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Murano colors may be incorporated into plastics or used as a coating on almost any surface. Either way, you'll obtain strikingly beautiful, lustrous effects.
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are metallized to a high-gloss chrome or gold color.

2. The metallized film is then laminated to flexible vinyl, with the metallized surface at the center.

3. Laminate is embossed on the top surface to give it dimension and style. Various patterns can be used.

4. The embossed lamination is coated on the reverse side with a high-tack pressure-sensitive adhesive, which in turn is backed by a heavy-weight paper backing.

5. Rotary die-cutting machines reduce the rolls to final desired width. At the same time rotary dies slice across the moving web, through the laminate (but not the protective paper carrier) reducing the basic pattern to presplit units. All water material is automatically removed and the desired web with basic patterns spools up on the rewind side for shipment. Prices will vary, but the pattern shown—2⅛ by 1⅞ in.—cost per thousand for decorated cutouts runs between $15 and $20, depending on quantity.

Foam package replaces cardboard

Versatile pack designed to hold any two of seven different models of servo motors made by Daystrom Transicoil Div. of Daystrom Inc., Worcester, Pa. The package is molded by Pycofoam Corp., Norristown, Pa., of Dylite (Koppers Co. Inc.) expandable polystyrene.

The new package has resulted in cost savings of 50 percent. Also, it provides better product protection and presents a more attractive appearance than the old unit. The latter consisted of a cardboard box holding only one single motor and requiring both a plastic film and corrugated board wrap to assure safety in transit.

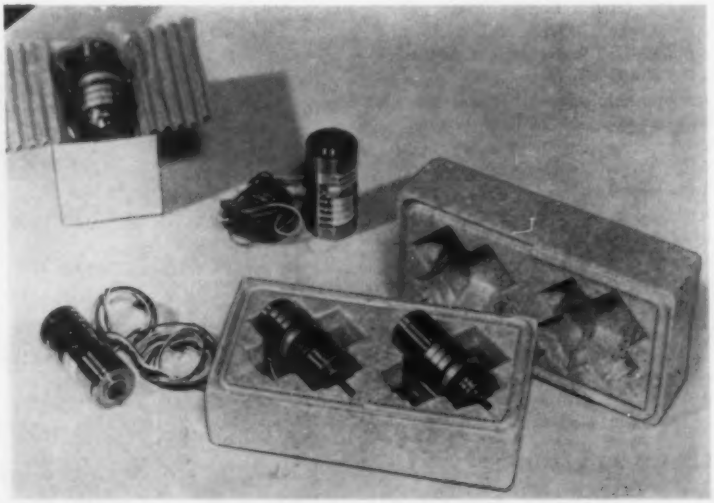
The motors shipped in these new containers go primarily into computer systems and aviation gear.

. . . And in brief

• Vinyl boat markers, 3 in. high and made in brilliant dayglo orange red, are produced by Trafficaide Corp., Auburn, N. Y. The numerals are reported to be longer lasting than paint and bond firmly to all surfaces without peeling. The material withstands the action of salts, strong or weak, and dilute acids, alkali, and gasoline and oils.

• Cold headed stainless steel inserts for molding into plastics components are available from The Carpenter Steel Co., Reading, Pa. The insert has a split head collar that is molded into the plastic housing with threaded end extended. Initially, the insert was made from carbon steel and brass. Then it was produced from stainless steels for high strength. The original stainless grades, in particular, caused premature galling of dies and non-uniform parts. The inserts are now made from Carpenter Stainless No. 10 and Type 430 stainless grades.

• Marine first-aid kit is packaged in container molded of Monsanto polyethylene for Forest City Products, Cleveland, Ohio, by Niagara Plastics, Erie, Pa. Product is reusable for carrying tools, maps, or anything else that needs to be watertight.—End



CONTAINERS ARE designed to hold various models of servo motors through molding in requisite contours into styrene foam. In left background is the package that was replaced.

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LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Manual for Plastic Welding—Polyvinyl Chloride," *by G. Haim*

Published in 1960 by the Chemical Publishing Co., 212 Fifth Ave., New York, N. Y. 324 pages. Price: $15.00.

Profusely illustrated, this is an excellent "how-to" book on the subject of welding and working with both rigid and plasticized PVC sheet material. The first five chapters discuss the chemistry, manufacture, and properties of PVC to provide the reader with a basic understanding of the materials he will be fabricating. The book then goes on to describe the equipment, processes, and associated techniques in the welding and fabrication of sheet material. Also included is PVC pipe and duct work. The book is easily readable and a most useful handbook to have around the welding shop for use by either engineers, supervisors, welders, or trainees.—*G.R.S.*

"Runnerless Molding," *by Ernest P. Moslo*

Published in 1960 by the Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 162 pages. Price: $4.95.

The first book devoted exclusively to this important subject in the field of injection molding covers machine and material requirements for automatic molding, nozzle design, molding thin-wall containers, multi-cavity runnerless molds, multi-nozzle manifolds, runnerless molding for large parts, valve gating, sequential impact molding, and the subjects relating to the production of molded parts without the need for external degating operations. An excellent summary of practical, up-to-date know-how on the subject.—*G.R.S.*

"S.P.I. Directory (1960-61)"

Published in 1960 by The Society of the Plastics Industry Inc., 250 Park Ave., New York 17, N. Y. 462 pages. Price: Members, $7.00; Non-members, $12.00.

This directory serves as a guide to the increasingly complex pattern of the plastics industry. Includes over 1100 company-members and 1300 individual members. More than 100 countries are represented in the foreign supplement. The book also contains *S.P.I. by-laws*, information on the society's 24 divisions, and a product index.

Adjustable speed drive. Design features, electrical and performance characteristics, dimensions, uses, etc., for Thymotrol d. c. adjustable-speed drives, which are used on extruders, surface grinders, wire re-winders, etc. Bulletin GEA-7018. 8 pages. *General Electric Co., 1 River Rd., Schenectady 5, N. Y.*

Vacuum pumps. Features, physical specifications, operational data, etc., for a line of mechanical vacuum pumps which produce pressures to 2×10^{-3} mm. Hg. or less; speeds from 7 to 132 cu. ft./min. Bulletin 8-15. 6 pages. *Consolidated Vacuum Corp., Rochester 3, N. Y.*

Catalyst for boat builders. Advantages, safety features, applications, etc., for Hi-Point 180 methyl ethyl ketone peroxide, a room temperature catalyst used in the polyester reinforced plastics industry, especially in boat manufacture. 2 pages. *U. S. Peroxygen Corp., 850 Morton Ave., Richmond, Calif.*

Product directory. Properties and uses for a complete line of polyvinyl acetate homopolymer and copolymer emulsions, solutions, and bead resins; styrene-butadiene emulsions; acrylic emulsions and solutions; polystyrene emulsions; vinyl and vinylidene chloride emulsions; polyvinyl alcohol; sodium polyacrylate thickeners; methyl acetate solvents; specialty monomers; as well as acrylon rubbers. 12 pages. *The Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.*

Polyethylene for packaging. Features, uses, properties, etc., for Rigidex high-density polyethylene for boilable packs, over-wrap film, detergent bottles, bottles and carboys, thin-walled containers, tote boxes, crates, closures, etc. 6 pages. *British Resin Products Limited, Devonshire House, Piccadilly, London W1, England.*

High pressure decorative laminates. Description, colors and patterns, finishes, sheet sizes, physical properties, specifications, uses, etc., for a line of high pressure decorative laminates. 22 pages. *St. Regis Paper Co., Panelyte Div., 150 E. 42nd St., New York 17, N. Y.*

Vinyl flooring. Fact sheet lists 10 residential types of vinyl flooring and describes their standard sizes and thicknesses in tiles and roll goods, style patterns, recommended care, durability, resilience, approximate retail prices and installation costs. Companion bulletin gives names and addresses of 18 leading manufacturers of vinyl flooring. *Monsanto Chemical Co., 445 Park Ave., New York 22, N. Y.*

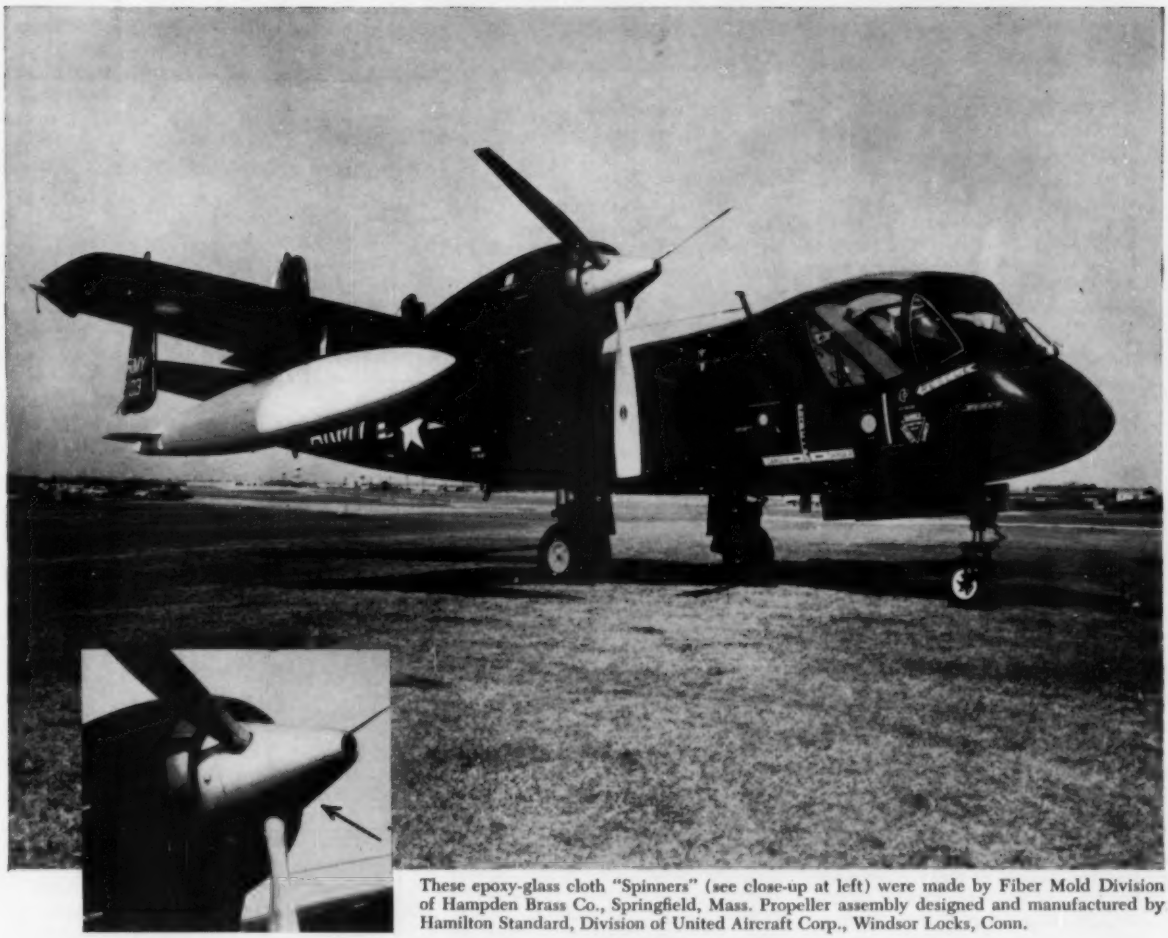
Molding facilities. Outlines the development and engineering facilities, as well as the compression, injection, plunger, fibrous glass-premix, and transfer molding; tool room and finishing equipment available. 4 pages. *Haas Corp., Mendon, Mich.*

Translucent wall units. Specifications, uses, types available, etc., for a line of translucent sandwich-type building panels consisting of two surfaces of reinforced fibrous glass-acrylic-polyester layers laminated with a special adhesive to an extruded aluminum gridwork. AIA File 17-A. 8 pages. *Seaporcel Metals Inc., 28-20 Borden Ave., Long Island City 1, N. Y.*

Molded polystyrene drawers. "Amos Mol-U-Line Molded Drawers" gives the features, sizes, uses, etc., for a line of drawers molded of high-impact polystyrene (Lustrex), and utilizing decorative Formica surfaces, for use in motels, hospitals, kitchens, offices, closets, etc. 6 pages. "New Dimensions with Molded Drawers" gives similar data stressing the Formica laminate applications. 8 pages. *Amos Molded Plastics, a division of the Amos-Thompson Corp., Edinburg, Ind.*

Multi-shielded a. c. motors. Prices, dimensional data, specialized mountings and enclosures, etc., for line of motors, ranging from ¼ to 200 hp., for use with extruders, injection molding machines, etc. Catalog 200. 56 pages. *Sterling Electric Motors Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.*

Anchor Extruded Plastics is a profusely-illustrated catalog outlining 1) facilities and typical products; 2) examples of both good and bad practices in designing extrusion cross sections; 3) physical properties, service characteristics, and application comparisons for the most commonly used plastic materials; 4) factors in choosing **(To page 182)**



These epoxy-glass cloth "Spinners" (see close-up at left) were made by Fiber Mold Division of Hampden Brass Co., Springfield, Mass. Propeller assembly designed and manufactured by Hamilton Standard, Division of United Aircraft Corp., Windsor Locks, Conn.

"SPINNERS" OF EPOXY-GLASS CLOTH

dampen vibration, maintain strength despite alternate icing and heating

One of the outstanding features of epoxy resin glass-cloth propeller "spinners" now being used on Grumman "Mohawk" airplanes is their predicted long, reliable service life. The epoxy-glass cloth "spinners," which incorporate molded-in wire element de-icers for the aircraft's propellers, possess excellent tensile strength and fatigue resistance—very important properties for a part that is subjected to severe vibration.

In addition, the wire heating elements, that are laminated right in with the glass cloth and impregnated with BAKELITE Brand epoxy resin-based compound, have excellent electrical insulation. The strength-to-weight ratio of the "spinner" is high and production costs are substantially reduced.

Here is another example that shows how BAKELITE epoxy resins possess the versatility, and physical and electrical properties necessary to meet exacting product requirements. For further information on BAKELITE Brand epoxies write to Dept. EK-87, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y.

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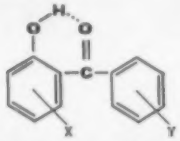
DOINGS AND FINDINGS

GREENHOUSES, SUNSHINE, AND STABILIZERS

Have you ever potted a plant or seeded a small patch of ground, and experienced the thrill of watching it blossom out? To raise the more exotic flowers, to extend the growing season, or simply to find more room when the grower's better half won't put up with any more plants in the house, the true enthusiast builds himself a greenhouse.

Now that polyethylene is available in weather-resistant formulations, horticulturists can put up a simple wooden frame and cover it with inexpensive, but surprisingly durable, polyethylene film. As might be expected, polyethlene-covered greenhouses are also becoming popular with the commercial grower.

It took some effort, of course, to develop a polyethylene formulation that could withstand the destructive ultraviolet rays in sunlight and yet permit the visible ones necessary for healthy plant growth to shine through. Eastman plastics laboratories found that non-pigmenting compounds having the general configuration shown here provided polyethylene with the necessary protection when dispersed in the material.



The success of these compounds in stabilizing the plastic lies not so much in their ability to absorb ultraviolet radiation as in their ability to dispose of it in easy stages, at no time releasing a harmful amount of energy to surroundings.

Although a number of compounds having the chelate structure shown above make satisfactory stabilizers, it was found by measuring the nuclear magnetic resonance spectra of these compounds (with a nuclear magnetic spectrometer—what else?) that the X and Y groups which strengthened the electronic density within the carbonyl group and decreased it within the hydroxy group improved the ability of the compound to rid itself harmlessly of the absorbed ultraviolet energy. The compound that had the configuration which proved to protect polyethylene best is now incorporated in certain formulations of Tenite polyethylene to make them unusually resistant to sunlight and weathering.

In addition to weather-resistant Tenite Polyethylene, Eastman also offers highly weather-resistant formulations of Tenite Polypropylene and Tenite Butyrate. For further information, drop us a line.

NEW SIGNS FOR OUR TIMES

If you've been traveling over the country on your vacation and have observed weathered and rusty signs, you'll be happy to learn that the day is at hand when signs can be lastingly bright and legible. No longer need sign lettering wear dim and become unreadable. In fact, producing a sign no longer requires paint. The thing that makes all this possible is a new two-layered, weather-resistant butyrate plastic sheet which we have developed ready for commercialization by custom extruders.

This duplex sheet is produced by a simple butyrate-to-butyrate sheet-coating operation worked out by the Eastman plastics laboratories. Although it has two layers of contrasting color, the sheet is a single, uniform thickness, with pigmentation change at its interface.

Shown here is a sign made from duplex sheet. First, the sheet was "drape-formed" over a mold which raised the lettering on the sign face. Then, surfaces of the raised letters were wet-sanded to remove their upper layer of plastic. This permitted the contrasting color of the plastic below to show through. Since the upper layer of a typical 100-mil sheet is only 10 mils, sanding takes just about 5 seconds. Water sprayed on during the sanding operation keeps down the temperature of the plastic and prevents it from gumming the abrasive.

We market only the resin and do not ourselves commercially extrude or fabricate sheet. But if you have some questions about duplex sheet, we will try to answer them. Write to Eastman Chemical Products, Inc., Plastics Division, Kingsport, Tennessee.

TENITE®
plastics by Eastman

dip tubes; 5) shrinking plastic solves some problem jobs; 6) an inside look at the Anchor operation; and 7) a guide to the design of producible cross sections, showing numerous examples of various configurations. 72 pages. *Anchor Plastics Co. Inc., 36-36 Thirty-Sixth St., Long Island City 6, N. Y.*

Thermosetting plastic knobs. Dimensions, specifications, etc., for a line of standard instrument and control knobs, dials, and assemblies produced in any thermosetting plastic. Catalog 106-C. 16 pages. *Kurz-Kasch Inc., Dayton 1, Ohio.*

Self-bonding nameplates. Features, applications, special effects, etc., for a line of Poly-Plate self-bonding nameplates, insignia, trademarks, logotypes, and brand names protected with Mylar shields. Bulletin 161-A (Supersedes 161). Includes sample. 4 pages. *W. H. Brady Co., 727 West Glendale Ave., Milwaukee 9, Wis.*

The Fabric of Space illustrates a variety of uses for Omohundro fibrous glass laminates, particularly their application in missile and aircraft components. 8 pages. *United States Chemical Milling Corp., 1700 Rosencrans Ave., Manhattan Beach, Calif.*

Diisocyanate compounds' bibliography. Supplement I. "Polyurethane elastomers." Compiled in Jan. 1960; 389 references. Supplement II, "Polyurethane Foams." Compiled in Jan. 1960; 461 references. Price: $5.00 each. Assn. members, $2.50 each. *Division of Rubber Chemistry, American Chemical Society, Rubber Div. Library, University of Akron, Akron, Ohio.*

Steam traps. Advantages, operation, specifications, capacities, etc., for a line of steam traps, which are used on heat exchangers, instantaneous heaters, steam radiators, sterilizers, coil heated tanks, vulcanizing presses, drying coils, etc. Catalog FE-310. 8 pages. *MIL Div., Farris Engineering Corp., 622 Commercial Ave., Palisades Park, N. J.*

Testing equipment. "The Wallace Rubber Micro Hardness Tester" gives features, specifications, and uses for this testing instrument, which can also be applied to PVC. 4 pages. "The Wallace Electronic Micro Indentation Tester" describes the function of this instrument used to measure the depth of penetration of an indentor into material under a known dead load. **(To page 184)**

SMALL STEAM TRAP
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New Design
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But don't let the small size fool you! ½" Sarco TD, for example, has capacity of 1280 lbs/hr, 150 psi, saturated steam temperature.

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Same trap and large capacity seat for all pressures, 10 to 600 psi . . . light or heavy loads. Self-adjusting. Has no valve mechanism. Only one moving part.

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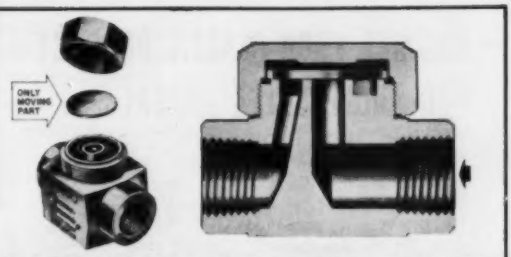

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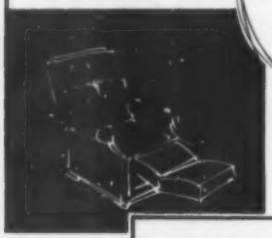

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"Measurement of the Degree of Cure of Polyester Resins by the Wallace Micro Indentation Tester." 4 pages. *Testing Machines Inc., 72 Jericho Turnpike, Mineola, N. Y.*

Spray painting machine. Specifications and features for a line of air-operated automatic reciprocating-type spray painting machines for spraying areas up to 12 by 40 inches. Brochure ET-400. 2 pages. *Conforming Matrix Corp., 364 Toledo Factories Bldg., Toledo, Ohio.*

Horizontal mixers. Dimensions, horsepower requirements, capacities, and other data for a line of horizontal mixers for mixing and blending plastics, chemicals, dyes, etc. Bulletin 128-A. 8 pages. *Sprout, Waldron & Co. Inc., Muncy, Pa.*

Extruders. Features, specifications, etc., for a line of 3½-, 4½-, and 6-in. plastics extruders. 8 pages. *National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio.*

Foam molding presses. Specifications, features, etc., for Series 1000 Millatron automatic press for molding expandable polystyrene. Similar data for Series 800 horizontal speed molding press; Dobar pre-expander; and Millaspander polystyrene foam block molder. 20 pages. *Miller & Van Winkle Co., Paterson 2, N. J.*

Bayer brochures. The following bulletins are available from Bayer: 1) "Meet the Bayer Plastics," a 98-page, 4-color brochure describing the company's range of products; 2) Three bulletins giving properties, uses, extrusion and injection molding data, etc., for Durethan, a polyamide-based caprolactam; 3) Similar data for Makrolon, a polycarbonic acid ester, 54 pages; and 4) Similar data on the Leguval-types of unsaturated polyesters generally cured as viscous solutions in styrene. 13 technical bulletins. All material in English. *Farbenfabriken Bayer, A. G., Leverkusen, West Germany.*

Injection molding machines. Specifications, features, and case histories for an entire line. Bulletin 100. 10 pages. *National Automatic Tool Co. Inc., Richmond, Ind.*

PE pipe compound. Test data, burst strength values, extrusion conditions, gloss, and other technical data for Bakelite DGDA-2033 Black 4865, a high-density polyethylene pipe compound. Release 20. 8 pages. *Union Carbide Plastics Co., 30 E. 42nd St., New York 17, N. Y.*—**End**

To mold

(*From pp. 90-92*)

Concentric and most eccentric shapes, balls and teardrops, etc., are almost impossible to mold to close tolerances. (Limited success has been obtained in molding these shapes in the rough and machining to tolerances. This method seems to be justified primarily for the semi-commercial new plastics, where stock shapes are not yet readily available.)

On the other hand, some shapes are virtually impossible to machine to accurate tolerances—intricate recesses or external contours, changes in plane, etc., such as gears backed on one side by a circular plate which has cam pins on its other surface.

A problem of another sort arises in the production of Teflon TFE parts. Because of the unusual method of fabrication (compression of particles followed by sintering at 720° F.) it is virtually impossible to mold parts with sharp shoulders to close contours.

Where the part may not be machined out of stock shapes because of an extremely large waste factor, Teflon specialists may recommend the compression-sintering method, followed by machining to achieve close tolerances.

It also may be advisable to follow the three-step method if the part requires a density of material greater than that of some ram-extruded rod.

Acrylic hearing aids and dentures which must match closely the convolutions of the human part, are often molded one at a time with plaster or temporary molds. (Routine contact lenses are usually machined from cast rod stock.)

Complex missile parts are often molded, regardless of the limited quantities, by molders specializing in premium short runs.

Three to 25 acrylic or other transparent parts with complex first or second surfaces (sometimes internally decorated) are most economically produced by hobbing—press embossing with a heated brass die or hob.

Below three, machining may be cheaper; above 25, molding. For signs or insignia with intricate internal patterns of raised lines, hobbing may be practical for up to several hundred pieces. (Like the various kinds of short run molding, hobbing is an art practiced by only a few specialists.)

Lead time

Machined parts may be obtained overnight, if required, since the setup usually involves only a little time.

Lead time on moldings, on the other hand, is a minimum of three weeks and usually closer to six, including mold design and construction.

Design changes

Changes in part design can be made during the run of a machined piece with virtually no extra cost or design change.

Any change in a molded part will add considerably to the cost of the run. If the change involves a decrease in dimensions, the mold will have to be reworked or a new mold required.—**End**

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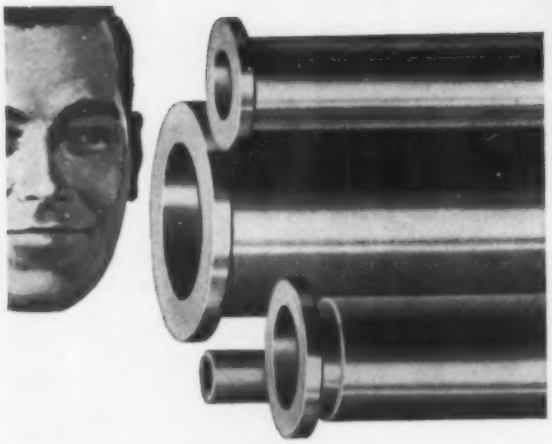

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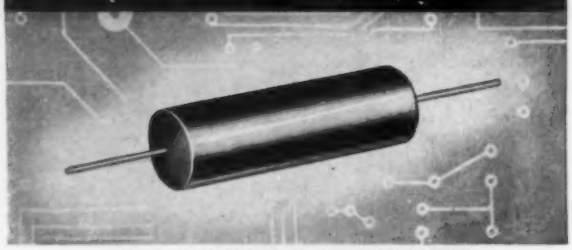

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Vinyls in construction

(*From pp. 83-88*)

and improve the properties of both. For example, a laminate of thin extruded films has been produced with a "spring" effect to replace bronze weatherstripping for doors and windows.

Perhaps most sensational of all at this moment is extruded strip used as a water stop in dams, between metal panels in curtain wall construction, and between concrete slabs in highways. Over 40 miles of this material are reported to have been used in construction of the St. Lawrence Seaway project. Scarcely anyone's imagination is capable of realizing how much potential volume is involved in this type of application when it becomes commonplace in dams, highways, as well as in building construction.

Today this extruded shape business is comparatively small—there was probably no more than 50 or 60 million lb. of vinyl resin used for all kinds of shape extrusions (exclusive of wire coating) in 1959. It is possible that 10 years from now a pile of all vinyl extruded shapes then in use would make Mt. McKinley look like a small hill in comparison.

Extruded shapes now in use

While window sash, piping, and conduits now account for most of the vinyl sales to the construction industry, other applications, some novel and some gaining rapid acceptance, point to significant growth in the coming years.

An example of a novel application is extruded rigid vinyl that has been applied as a flat horizontal facing, or fascia strip, on a Cleveland, Ohio school building. About 5000 ft. of 60-mil sheet was installed over a sheet metal channel at the edge of the school roof, and after seven years of weathering, the fascia is reported still to be in excellent condition. Cost of the installation was estimated to be some one-third less than the cost of a porcelain-coated sheet metal job. Another big advantage of the vinyl fascia is that there is no staining of the school walls from rusting and corrosion of sheet metal fascia. The vinyl sections were extruded by Seiber-

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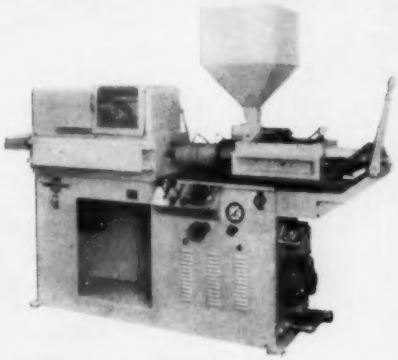

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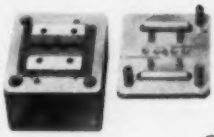

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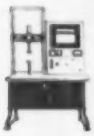

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ling Rubber Co., Plastics Div., Newcomerstown, Ohio, and the design was developed by Industrial Roofing and Sheet Metal Inc., Cleveland, Ohio.

One application gaining in public acceptance, according to Navaco Inc., Dallas, Texas, is its line of rigid vinyl awnings (see photo, p. 86). Probably the greatest boost to sales, says the company, was the performance of these awnings during a violent hailstorm in Denver, Colo. Almost all metal awnings were bent or paint-nicked, but not one rigid vinyl awning was damaged by the storm, according to the company.

The awnings are made by joining extruded vinyl slats with aluminum crossbars, leaving precisely-engineered spaces between the slats for proper ventilation.

Semi-rigid vinyl railing cap

Not all applications of vinyl in building are based on the replacement of established building materials, however. In some cases vinyl can be combined with other materials to enhance their value to builder and purchaser. For example, the combination of a vinyl cover with low-cost metal base stock can produce an attractive and economical stair railing. In the East Lansing research house of the NAHB, a semi-rigid vinyl cap, extruded from Goodrich Geon 82126 resin, was fitted over an aluminum (Reynolds Metals) bar stock railing. The railing cap is installed by feeding the vinyl strip through a hot air chamber until it is flexible, then fitting it over the metal rail. Splices are made by heating the vinyl ends with a wide-blade electric knife and butting the ends. The applied cost of a vinyl-capped steel bar stock railing is said to be competitive with the cost of extruded aluminum rails, and less than the cost of bronze, stainless steel, or anodized aluminum railing.

More than 200 million linear ft. of architectural stair railing is used each year in interior commercial construction. Wood, aluminum, and wrought iron are usually selected for such applications, but both wood and metal railings are subject to damaging or staining, and the metal rail generally imparts a cold feeling to the hand. Vinyl capping will provide not only durability and stain resistance, but also a surface that is pleasant to the touch and dry for safer gripping.

Double-duty baseboards

Just as high-temperature vinyl piping may make prefabrication of wall sections of houses more practical, so, too, does the use of extruded vinyl baseboard moldings. Baseboard moldings are normally intended to conceal the joints between walls and floor and to protect walls during floor cleaning. However, with the trend today to pre-fabricated wall panels, location of electrical wiring outside the walls has become more practical, and the newest function of vinyl baseboard moldings has been to carry multiple wiring systems through complex profile extrusions.

Vinyl baseboards offers durability, resistance to denting and abrasion, dimensional stability, integral color, ease of installation, and maintenance freedom. When serving in the additional role of electrical raceways, vinyl moldings also offer good electrical insulation, fire resistance, and moisture resistance.

However, lowered cost of labor is the big advantage with combination baseboard molding-electrical raceway. The cost figures of a typical installation in Cleveland illustrates this. Using an average 300 ft. of molding per house, standard wood molding at 12¢/ft. would cost $36, and vinyl molding at 40¢/ft. would cost $120. But labor cost of installing wiring beneath a wooden base molding comes to $4 per outlet, while with vinyl the cost is only $2 per outlet, thus when approximately 50 outlets are used in a home, the saving of $100 in labor costs more than makes up for the differential in material cost.

Among the manufacturers of vinyl baseboard molding, or suppliers of vinyl extrusions for such uses, are: Johnson Plastic Corp., Chagrin Falls, Ohio; Vinylex Corp., Knoxville, Tenn.; Crane Plastics Inc.; and National Electric Products Corp., Div. of H. K. Porter Co., Pittsburgh, Pa., which furnished the vinyl base molding with wiring channels for the

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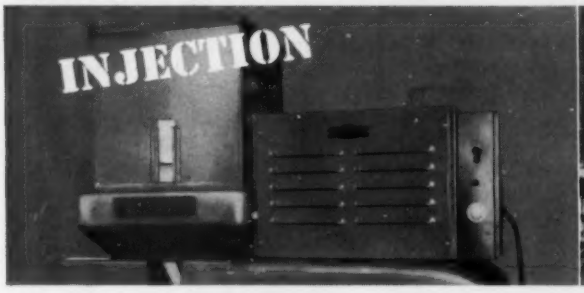

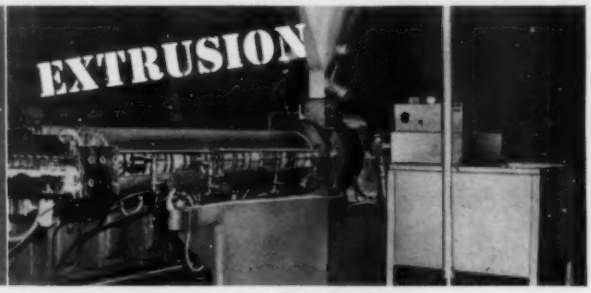

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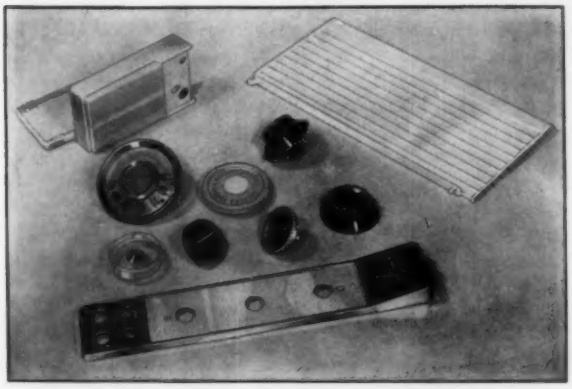

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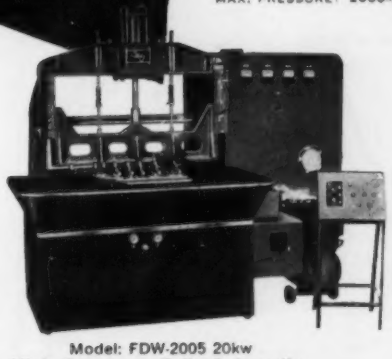

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NAHB house. Johnson Plastic Corp. supplies solid vinyl moldings in standard widths from 1½ to 6 in., and in lengths of either 50 or 100 ft., eliminating the many seams required with cut lengths of rubber or wood moldings. For smaller jobs, however, 4-ft. vinyl strips are also available. Baseboard molding from Vinylex Corp. is available in either 50-ft. rolls or 4-ft. strips, packed 100 ft. per box, in widths that range from 2½ to 6 inches.

Flexible vinyl building products

Much of the recent growth in the use of flexible, plasticized vinyl weatherstripping and gasketing came with the development of light metal window and door units, and the now-famous curtain wall panels of metal and glass. These products had been demanded by architects and builders, who were faced with a 30% rise in labor costs over the past decade and wanted construction parts that could be preassembled and would be easier to install and maintain.

Flexible vinyl weatherstripping (and rigid materials to some degree, as seen in the Chicago Airways Hotel application) gained wide acceptance as sealants for these panels by outperforming the conventional caulking compounds, which usually required replacement every three to five years. The longer life of vinyl weatherstripping—due to its resistance to ultraviolet rays, embrittlement, hot and cold extremes, abrasion, and discoloration—has encouraged those in the weatherstripping industry to prepare a set of performance standards, and today there is a Commercial Standard as an assurance of quality to purchasers of vinyl weatherstripping.

Vinyl spline is generally referred to as a type of weatherstripping since it does have a weathersealing function, but it has the additional job of holding screening in place. Kriedel Plastics has developed, for Owens-Corning Fiberglas Corp., a square spline (most are tubular) which securely anchors Fiberglas screening to its framing. The flexible vinyl spline holds the screen firmly so it won't sag, yet can be easily removed if re-screening is necessary.

Crane Plastics has developed a screening spline known as "Denscell." This is a low-density cellular product. Prior to extrusion, a small amount of blowing agent is introduced into high-density vinyl material. The heat of extrusion completely decomposes this blowing agent and this acts to liberate the gas within the extruder barrel, and the gas-filled extrudate then expands as it emerges from the extruder die.

In addition to being lower in density, the spline is lower in cost and improved in compressibility and resiliency over solid tubular vinyl spline. However, tensile strength drops, and the spline is not recommended for applications where this property might be considered critical.

Extensive use for vinyl waterstops

One facet of construction which extruded sections of plasticized PVC have virtually taken over is that of waterstops and expansion joints, used in the construction of concrete foundations, retaining walls, pavements, bridges, and dams. The vinyl products have proved superior to a long line of conventional materials—asphalt, asphalt-coated steel, wrought iron and copper channels, as well as rubber—for bridging the joints between concrete blocks and preventing the seepage of water into the joints.

Metal waterstops, particularly copper, proved successful in the past, but the joining of copper sections by welding and brazing techniques was costly and time-consuming. Rubber waterstops were an improvement over the metal, but splicing of rubber strips required costly vulcanizing equipment, and the rubber often hardened and became brittle after it was in service for a while.

Splices are made in vinyl waterstop by heating two vinyl sections until the vinyl has melted back slightly, holding them together for about 45 seconds. These splices have, at minimum, 80% of the strength of the unspliced waterstop length. The waterstops are fitted horizontally

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or vertically into formwork prior to pouring of concrete. In many ground level installations, half of the waterstop width is embedded horizontally into the foundation, then bent up vertically before pouring of the concrete wall, thereby providing a 90° seal against any water.

The "Rex-Tite" waterstop marketed by American Enka Corp., Concord, Mass., is described as a polyvinyl chloride material compounded with a special polymer-type plasticizer. The flexible material, which is available in widths ranging from 5 to 9 in., offers high impact strength, tensile strength, as well as chemical resistance. Vinylex Corp. supplies both the ribbed and the hollow-bulb type waterstops, in rolls of 25, 50 and 100 feet.

Electrovert Inc., New York, furnishes its "Durajoint" and "Duraseal" waterstops in three types. Type 18 is a combination expansion joint and waterstop designed especially for vertical joints. Type 20 is a narrow-width material for masonry control joints where low cost fillers or caulking compounds are to be used. Type 21 is designed to cover the entire joint, eliminating the use of fillers.

American Sisalkraft Corp., Attleboro, Mass., has developed an extruded vinyl strip for low-cost forming of contraction joints in concrete pavements. The product consists of a V-shaped channel into which is fitted a T-shaped spreader strip. The two-part vinyl strip is vibrated into wet concrete through the use of special machinery, and is removed once the concrete has set. Removal is considerably simplified by taking out the T-shaped strip, which collapses the walls of the V-shaped channel.—**End**

• • •

In a forthcoming issue, the second article in this series will review the building uses of vinyl film, sheet, and coatings. Included among the applications in this article will be: moisture vapor barriers of vinyl film, shutters thermoformed from vinyl sheet, and several examples of vinyl-coated aluminum and steel construction parts.

Autoclavable carafe

(From page 89)

that it is possible to reach inside for thorough cleaning. Seamless construction prevents bacteria-snagging cracks.

Two-thirds lighter than conventionally used stainless steel and glass pitchers, the new containers are unbreakable, undentable, and are pleasant to the touch. They have a sufficiently high heat resistance to take autoclaving without ill effects. Hospital autoclaving temperatures run generally somewhat above 250° F. Field tests on the polypropylene carafe indicate that it can withstand temperatures up to 275° F. Earlier thermoplastic carafes supplied by American Hospital were rated at 249° F. maximum.

How it is made

The carafe holds 1 qt. of liquid. Wall section of both carafe and lid is 0.070 inch. The units are blow molded by Plastics Assembled Products, Baltimore, Md., on a double-head machine made by Boston Plastic Machinery, Inc., now merged with Modern Plastic Machinery Corp., Clifton, N. J.

To avoid outside flash on the sides of the bottle and lid, the unit is needle blown. Biggest difficulty in this process was to find a needle strong and small enough to pierce the tough PP parison.

Using polypropylene, this cycle is 10% to 15% longer than could be expected if the part were blown from high-density polyethylene, but rejects have been practically nil. The carafe is blown in an aluminum mold with a steel pinch off. After pinch off, the lid is cut off at the neck of the carafe. Both parts are then finished by spin reaming, which smooths both the inside and outside of the drinking edge of the cup, trims it to insertable size, and smooths the opening at the top of the bottle. Price for the decanter is $1.60 each in gross lots.

Now that the first PP bottle has been successfully blown, we can look forward to vigorous growth in this area, especially for markets having high heat requirements. And once polypropylene has been blown, can vinyl be far behind?—**End**

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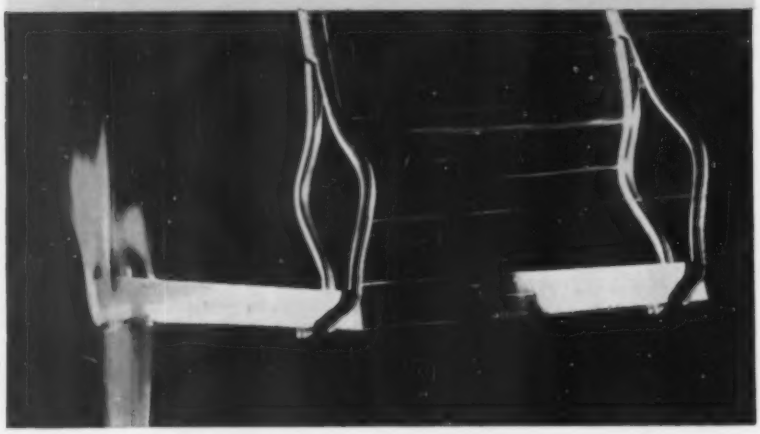

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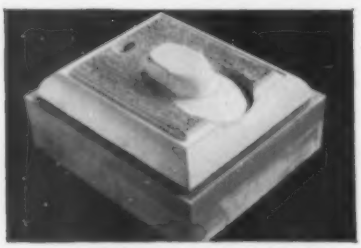

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Dolls

(From pp. 100-103)

molds to form deep eyesockets into which the eyes were inserted (using special tools from Margon) from the front. Such eyesockets, of course, were not possible with the hard heads.

The housing for the individual eyes was originally two drawn steel covers enclosing the eyeball and providing an oval opening in the front. This construction later became a steel front cover with the oval hole and an injection molded back cover. Styrene was first used, and, when it became available in 1958, Margon switched to polypropylene. The latter provides the desirable characteristics of easy moldability, high impact strength, adequate stiffness, complete resistance to plasticizer migration, low coefficient of friction (an abrasive force could destroy some of the eye make-up during assembly), and low cost.

Although the sleeping doll eyes comprise Margon's largest single item in its line, the New Jersey concern also makes: 1) *Lenses,* which are set into vinyl, plush, or molded doll and toy heads to simulate stationary open eyes; 2) *unit eyes,* which are a pair of miniature eyes molded into one piece, including trunnions and weight; 3) *rolling eyes;* 4) *follow eyes,* a sleeping eye that is designed with concave white and iris portion to give the illusion of looking at the viewer from any angle; and 5) *rock-to-sleep eyes,* which are sleeping eyes that will only close when the doll is rocked.

Acetate wigs are popular

The development of doll wigs has been as sensational as the dolls themselves. A chronology of this change would probably read: human hair, mohair, fur, nylon, saran, and acetate.

Wiggy Inc., Brooklyn, N. Y., which has supplied hair to the doll industry since 1949, first used mohair. But this material was not washable and could not be rooted. A fur substance was tried for a short time; but, although it could be washed, it had few other advantages, and like mohair it had to be pasted to the head. Wiggy

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changed to saran about 1950. Now most of the wigs, which fit dolls ranging from 11 to 40 in. and are available in almost any color, are acetate.

"We switched to acetate because of its greater yield per pound over saran," commented Arthur Alpert, president of Wiggy. "If another material comes along that is lighter and cheaper, I'm sure we will consider it very carefully."

Mr. Alpert listed the advantages of acetate (also saran) wigs as their: 1) play value; 2) washability; 3) ability to retain curl; and 4) similarity to human hair.

Surprisingly, one of the largest consumers of plastics is the huge doll clothing and accessories field. Virtually all of the accessories—nursing bottles, shoes, clothes hangers, rattles, dishes, training seats, etc.—are plastic. Nylon and acetate are used in clothing and hosiery, but most of the dresses are still cotton—it's cheaper.

"Plastics have come a long way in a very short time in the doll accesory field," explained David Kass, Sales Manager for Progressive Doll Accessories Corp., New York, N. Y. "The accessories that we used to make with glass and metal are now virtually all plastics. We use a variety of these materials, including PE, vinyl, styrene, acetate, and the high-impact plastics."

On an industry-wide basis, Mr. Kass estimated poundages thusly: Polyethylene, 250,000 lb.; vinyl, 150,000; styrene, 150,000; acetate, 100,000; and the high-impact plastics, 50,000; for a 700,000-lb. total.

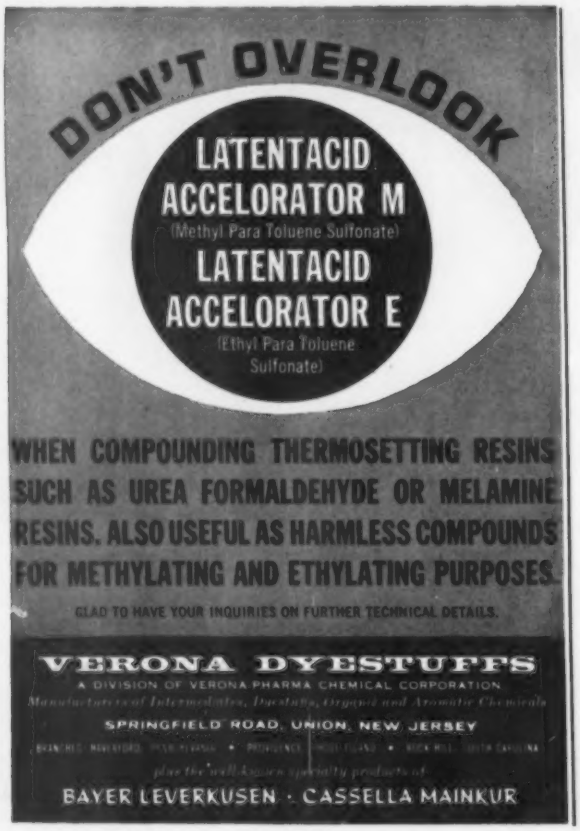
"The future for plastics in the doll accessories industry is a bright one indeed," Mr. Kass concluded. "Based upon the rapid past growth, and the constant development of new items requiring plastics, it is easy to see an ever expanding market with sizable increases in material usage."

Packaging accounts for big market

Still another big consumer of plastics is the complex packaging end of the doll industry. A few years ago, the cardboard box was the most glamorous package available. Even with the addition of a cellophane window, the box hardly did justice to the beautiful dolls. Then acetate containers and PE bags entered the picture. But a recent addition is the corrugated box with heavy-gage acetate window, combining: 1) easy visibility; 2) sturdiness; and 3) attractive printing equivalent to printed folding box.

In addition to their merchandising advantages, the plastics, of course, protect the dolls during handling, thereby reducing the retailer's costs. Practically all doll clothing is packaged in little individual PE bags (accounting for thousands of pounds of the resin), and acetate blister packs are popular for such items as shoes.

As illustrated by the aforementioned statistics, plastics have had a large share in upgrading the multi-million-dollar doll industry. They have brought both increased profits and production economies to their users; and, as the inevitable expansion of this vast market is realized, plastics will do an even more dramatic job.—**End**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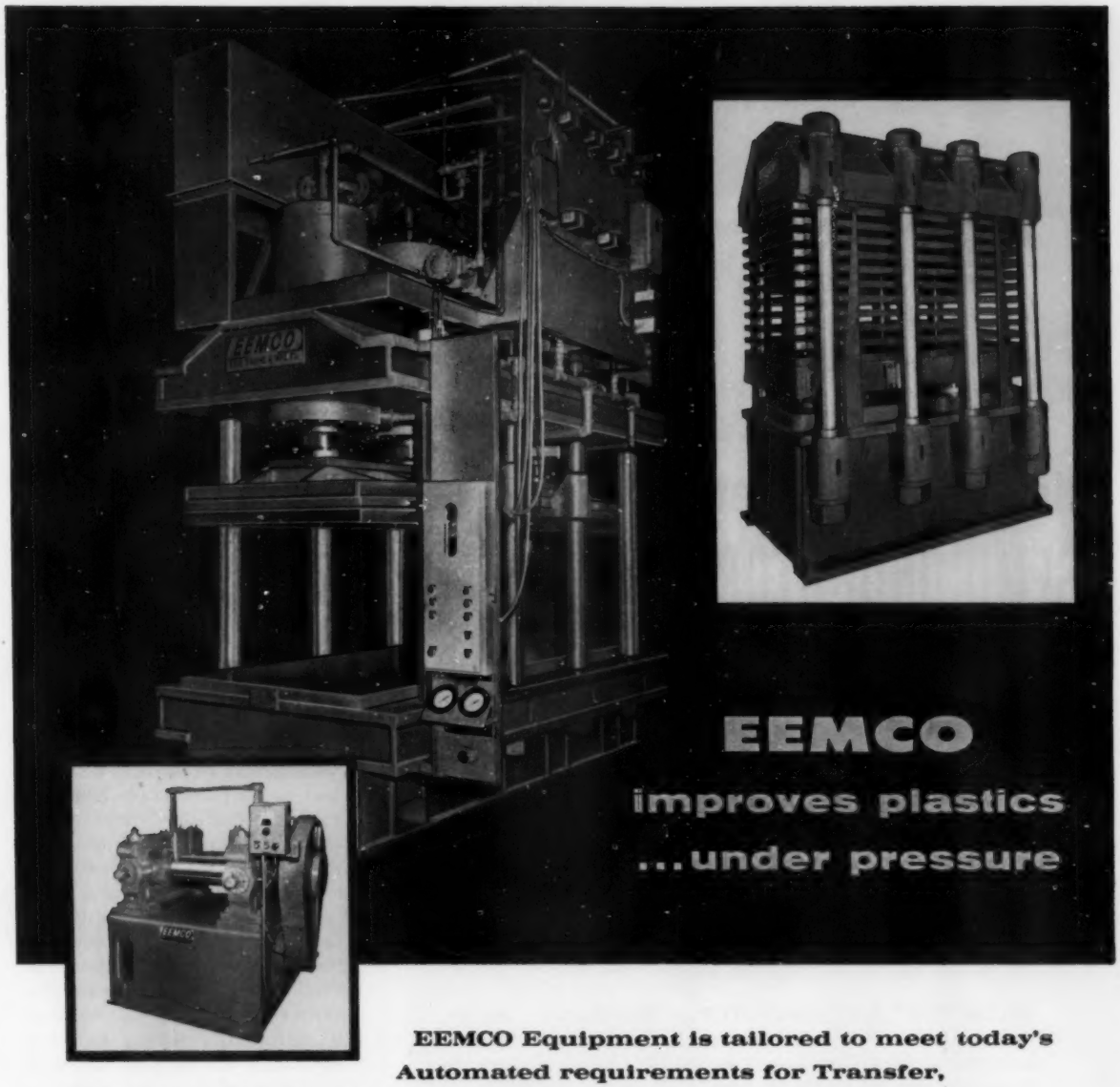

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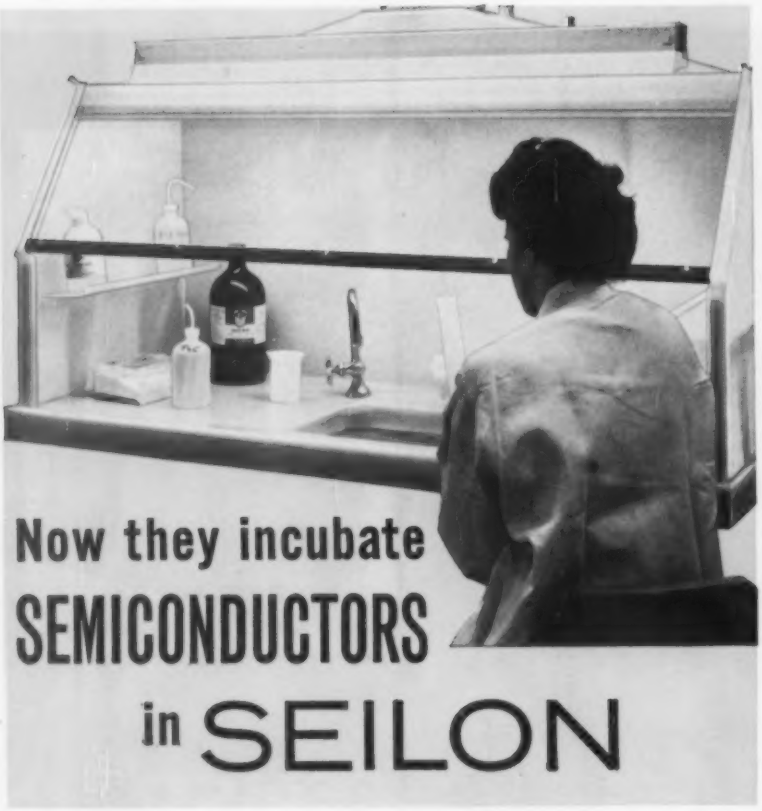

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Melt extractor

(From pp. 107-110)

units in the United States; various machinery makers state these machines are outselling single stage machines three to one.

The use of a melt extraction cylinder in preplasticators seems only natural in view of its superior performance over the torpedo type cylinder which is often used for preplastication.

Field results

This system has been mounted on a 12 oz., Type 300-T Reed-Prentice injection machine. On this converted 12-oz. machine, it was possible to mold high-density polyethylene (Grex 60-050E) into a baby bath tub which had a projected area of 350 sq. in. and weighed 31 oz., or about 2½ times the rated capacity of the machine prior to conversion (See Fig. 9, p. 110). The machine was powered by a 30-hp. motor and a clamping force of 300 tons was used while molding the tub at a rate of 50 pieces/hr. The 300-ton clamp converts to a locking pressure of 1717 p.s.i. as compared to the 2500 p.s.i. recommended for other types of preplasticating machines. The mold previously had to run on a conventional 60-oz. machine using low-density PE and only produced 25 pieces/hr., or one-half the rate of the converted machine. Obviously, the return on the investment in the 12-oz. machine is increased. Another operating advantage is the more efficient utilization of injection pressure, since the ram operates against thoroughly plasticated melt on the injection stroke. Experience on other molding trials with various thermoplastics is shown in Table I, p. 110.

In addition to the obvious operating and economic advantages, parts of all materials molded with better surface finish, lower internal stresses, and relatively little warp even with the more difficult molding materials. Especially interesting was the fact high-density polyethylenes could be run at the same temperature of 430° F. as the low density material with minor increases in mold temperature and at pressures that were no greater than those needed for

high impact polystyrene. The injection temperature could be maintained at a lower level than was required in conventional units, which is significant in the processing of heat sensitive materials and in the reduction of cycles.

With the need for uniform low temperature plasticized material, this unit seems ideally suited for blow molding. A large charge of thermoplastic material would be available at fast parison extrusion rates for intermittent operating type of machine design. To this date, however, no work has been done along these lines but it seems entirely feasible.

Conclusions

The Straight Line Melt Extractor Preplasticizer offers the following advantages:

1). Higher production rates.

2). Better pressure and temperature control at lower levels.

3). Possible overall reduction in cycle time.

4). Reduction of internal stresses.

5). Better dimensional and shot weight control.

6). Improved surface finish.

7). Ability to mold larger projected areas with more economical use of machine horsepower.

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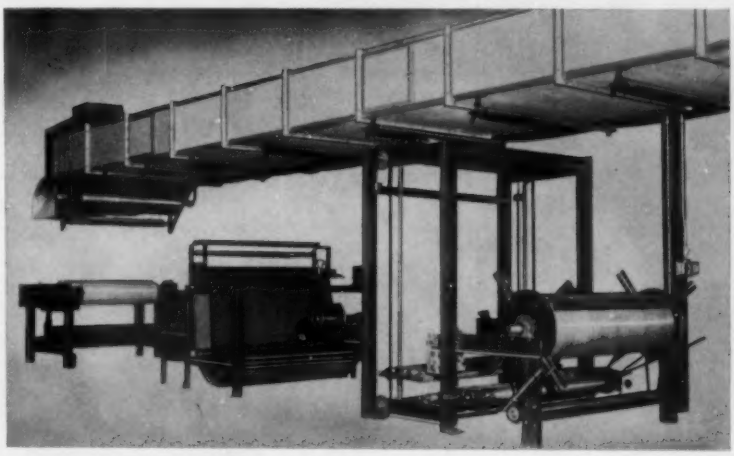

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Dimethyl Sebacate	0.986*	3.54 @30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins	High Solvency and Efficiency, Wide Compatibility, Concentrated Source of Sebacyl Radical
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate	Excellent Low Temp. Flexibility, Low Volatility, Excellent Soapy Water Resistance, Good Electricals

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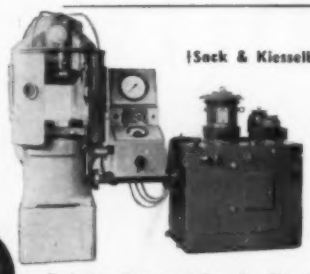

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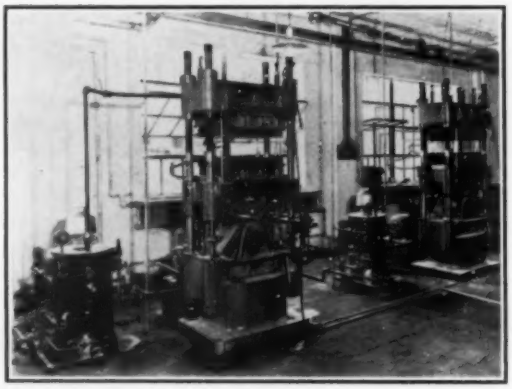

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Orientation

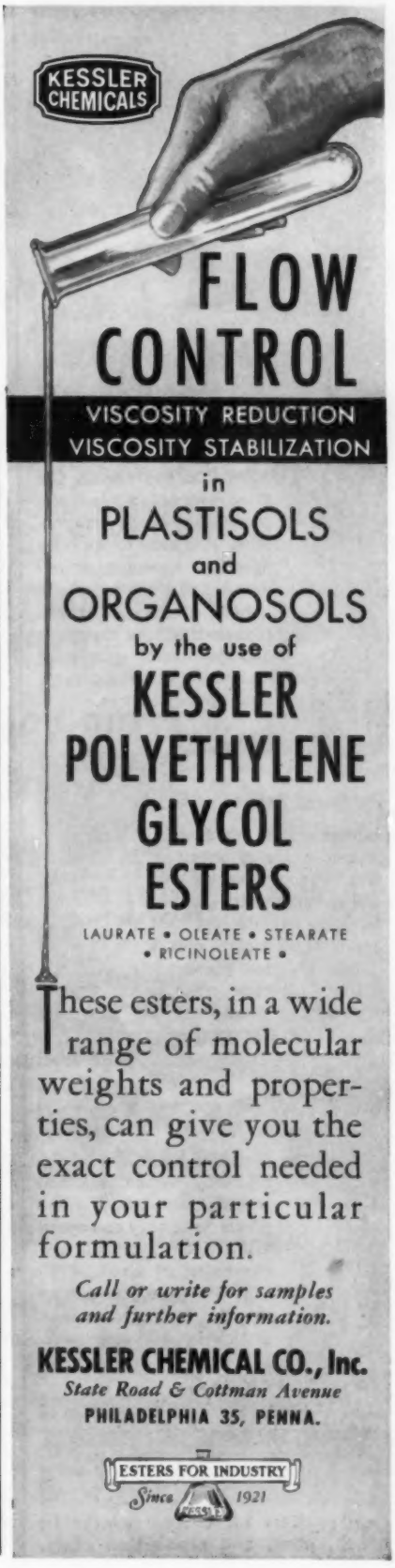
(From pp. 113-124)

Orientation decreases with increasing die temperature because of more relaxation after flow stoppage. It might be expected that in some full shots, higher die temperature might delay gate sealing and allow greater "packing," producing more orientation. However, the relaxation effect must completely dominate, since no instance of this behavior was noted in this study.

Ram forward time

Ram forward time (RFT) has a marked effect on the molecular orientation of the molding as shown in Figs. 16, 17, and 18, pp. 121-122, for single-cavity shot and Fig. 19, p. 124, for the two-cavity shot. Fig. 16 shows the effect of RFT on the orientation of the 75-mil bar preceded by the 30-mil gate. The curve rises steeply, then levels out at about 7 seconds. Of course, when the ram is withdrawn prematurely, most of the orientation present in the still hot polymer is able to relax out. The longer the ram is held forward, the colder the stock becomes and the more orientation is retained. This holds true up to 7 sec. when the thin gate seals, isolating the cavity, and preventing the RFT from exerting further influence on orientation. Examination of the original data shows that as far as viscous flow is concerned, the gate seals at about 5 seconds. These data also show that there is still some transfer of shear stress to the cavity for approximately 2 sec. after measurable plastic forward motion ceased.

Fig. 17 illustrates the same type of data, but this time the 75-mil bar is preceded by the 120-mil gate. The flow of this system is controlled by cavity sealing. Plastic forward movement is significant up to about 10 seconds. Orientation continues to increase for still longer, again indicating considerable molecular stretching even in the absence of viscous flow. Fig. 18 compares the results of the previous two curves. It is apparent that the rapid sealing of the small gate results in considerably less net orientation in the molding. The two-cavity results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are shown on Fig. 19, p. 124. In this comparison the gates are the same (120 mils thick) but the cavities differ (75 vs. 150 mils thick). As would be anticipated, the thin bar shows much greater degree of orientation than the thick bar. There is no evidence of sealing in either of these cases. The 150-mil bar becomes full at the 30-sec. RFT point, and this premature loss of motion does result in a slight reduction of orientation.

Cavity thickness

The last molding variable considered was die cavity thickness. The effect of this variable on orientation is shown in Fig. 11 and Fig. 20 on p. 124. The thinnest (75-mil) cavity shows the greatest degree of orientation and the thickest (300-mil) cavity shows the least. This happens for two reasons: first, shear stress is higher in the thinner cavity and second, there is less relaxation. The basis for the first part of this statement is less obvious than the second part and, therefore, derives from this reasoning.

The volumetric flow rate entering a cavity is independent of the cavity thickness as it is controlled solely by the system preceding the cavity. Thus, the velocity of the melt entering a thin cavity is higher than that entering a thick cavity if all other conditions are equal. Consequently, for a considerable part of the time in which the cavity is filling, the shear rates of corresponding radial positions are higher for the thin cavity than for the thick one which necessitates that shear stresses must also be higher in the thin cavity.

Conclusions

A mechanism of non-isothermal plastic flow has been postulated which is consistent with birefringence patterns observed on polystyrene injection moldings. These patterns were explained by showing that they are composites of two competing effects, i.e. molecular orientation induced by shearing forces during flow and relaxation after these forces are reduced when flow stops.

The principles implicit in this mechanism have been used to understand the effect of molding variables on orientation. This re-

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Birefringence was calculated using

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where the wavelength of the polariscope white light source, λ, was estimated to be ca. 5500A. The retardation, R, was determined by counting the number of orders and assigning the various colors the following fractional order values: Yellow, 0.3; red, 0.7; green, 1.0; so that for example a twelfth order yellow would have a retardation of 11.3, a sixth order green would be 6.0, etc. D is the thickness of the specimen.

lationship depends upon several compensating factors so that the particular result of a change in operation will vary with the specific molding environment under consideration. However, several generalities relating both to the effect of operating conditions and die geometry can be made.

A. Usually orientation decreases as these increase: 1) Die temperature; 2) cavity thickness; and 3) cylinder temperature.

B. Usually orientation increases as the following increase: 1) Gate size; 2) ram pressure; and 3) ram forward time.

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The authors wish to acknowledge the assistance of Drs. R. I. Dunlap, R. L. Heider, and Lawrence Nielsen; and Messrs. G. W. Ingle, T. Shusman, G. C. Claver, and L. Child.—*Ed.*

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How to extrude

(From pp. 127-131)

through a flexible pipe to an air-driven pump. The pump could supply plastisol to the extruder at 200 p.s.i. The equipment is shown in Fig. 4, p. 128.

Advantages of pump-feeding were at once evident. High, steady extrusion rates were obtained. Higher temperatures could be used without gel blocking. Good pressure profiles were obtained at both low and high head pressures when compared to those using a hopper feed (see Fig. 5, p. 131). Figure 6, p. 131, photographed just after a run on the modified equipment, shows the screw channel completely filled.

An interesting observation was that plastisols require less drive power than pelletized feeds. This is explained by the fact that plastisols are liquid and unlike pellets, very little work is needed until they are fused. Since mechanical input is reduced, more heat must be put in by conduction. The Brabender Plastograph curves in Fig. 7, p. 131, show the difference in drive inputs for pellet and plastisol materials.

Extruder heat transfer capacity may, therefore, become a limiting factor in plastisol extrusion. No evidence to date indicates that this limitation has been reached. One advantage of plastisols offsetting this limitation is that, being liquid, they contact the extruder barrel better, thereby aiding heat transfer.

In practice, this reduced energy requirement is shown in Table II, p. 131. Pertinent data are summarized for the test runs described in this article. For about equal die pressures, the mechanical work needed to process Plastisol A is about one-half that needed for pellets prepared from this plastisol. The same is true for Plastisol B.

Pump-feeding offers a simple, practical solution to the prior problems met in plastisol extrusion. As well as solving gelation problems, it is far more practical than a hopper for feeding liquids into an extruder. There is every reason to believe this process can soon achieve wide commercial usage.—**End**

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A difficult design problem in Sunbeam's new de luxe vacuum-cleaner line involved the turbine brush sweeper accessory. The turbine brush combines the advantage of a power-driven brush, previously found only on uprights, with the power and flexibility of a tank-type cleaner. This brush is powered by a unique one-piece fan wheel made up of 54 curved blades, spaced to allow the intake of metallic objects such as paper clips, hairpins and the like.

For satisfactory operation of this turbine wheel, an exceptional material was required—one with high strength in thin sections, resilience, and resistance to metallic impact. The material had to be intricately molded to close tolerances in an economical one-piece molding. In addition, lightness of weight, abrasion resistance, and good bearing properties were needed. The solution: a wheel molded of Du Pont ZYTEL nylon resin, which fulfilled all these requirements. The successful design of this component, molded by Chicago Molded Products Corporation, for Sunbeam Corporation, both of Chicago, Illinois, also permitted the over-all design of the sweeper unit with a low profile for maximum furniture clearance.

On the following page, you will find some additional examples of the basic design improvements made possible by the use of ZYTEL nylon resins.

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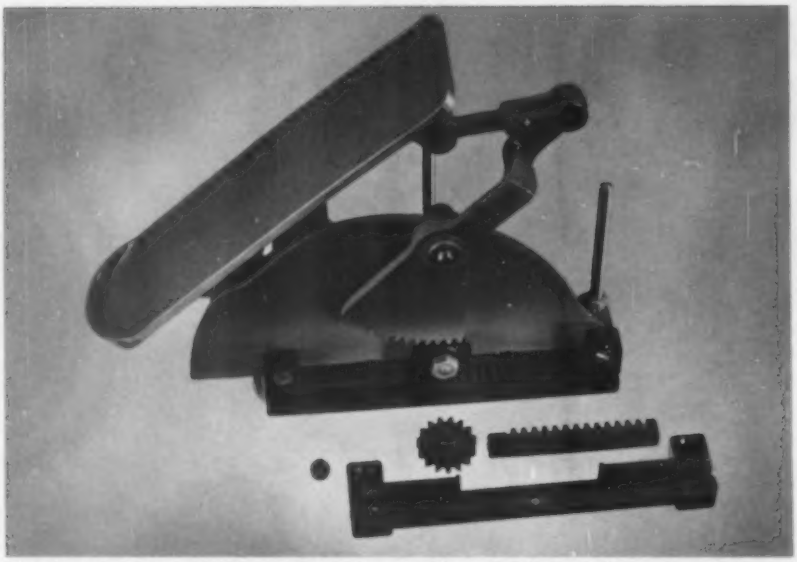
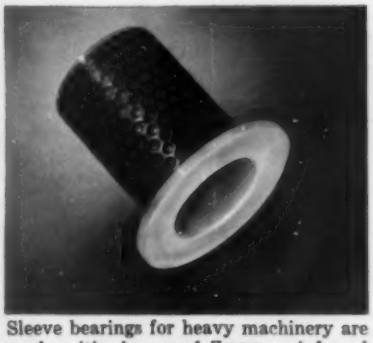
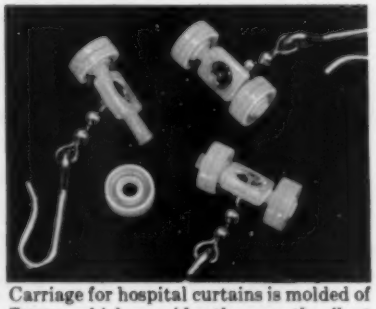


Full-throttle foot control for motor boats is made with gear, rack, guide panel and anchor ball of ZYTEL nylon resins. The rack and anchor ball have threads molded in to accept the control cable and sheath respectively. The use of ZYTEL assures smooth, quiet operation of the foot control, and eliminates salt-water corrosion problems. In addition, the unit requires no lubrication. (Molded by Nylon Products Corporation, Clinton, Massachusetts, for Tempo Products Company, Cleveland 3, Ohio.)



Sleeve bearings for heavy machinery are made with sleeves of ZYTEL, reinforced with a steel backing that has indented perforations and press-fits into the bearing housing. The good flow characteristics of ZYTEL enable it to flow easily into place through and around the many perforations. ZYTEL provides the necessary abrasion resistance, impact strength and low noise factor. (Molded by Terhorst Manufacturing Company, Minot, N. D.)



Carriage for hospital curtains is molded of ZYTEL, which provides the smooth, silent operation required in hospitals. This long-wearing part is easily assembled by snap fitting, needs no lubrication. (By Capital Cubicle Company, Brooklyn, New York.)

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ABMA program

(From pp. 135-140)

nates in which the layers of reinforcement are parallel to the surface.

Two models of an asbestos-reinforced phenolic were made in exactly the same manner except that the molding pressure was 300 p.s.i. for one and 100 p.s.i. for the other. Under the same test conditions (600 B.t.u./ft.^{2}-sec.), the low pressure molding ablated at the rate of 0.032 in./sec. and the higher pressure molding ablated at the rate of 0.021 in./sec.

Since the liquid layer on the surface flows downstream under the influence of pressure gradients and aerodynamic friction, the viscosity and surface tension of the reinforcement in the molten state must be selected to conform to the thermal environment. A situation in which the molten reinforcement stands as droplets on the surface is less desirable than one in which the melt spreads uniformly over the surface. A uniform blanket of glass on the surface adds to the stay-time of the resin in the hot reaction zone. This consideration is sufficiently important to justify special additives to the reinforcing fiber material to reduce surface tension.

As is consistently true in materials development, the absolute test of a material or concept is in evaluation under the actual conditions for which the system or material was developed. For this reason, test flights with recovery were included as a part of the development program. Four successful re-entry and recovery test flights have been accomplished to the date of writing.

A scale version of the tactical Jupiter nose cone was flown and recovered as early as August 1957. Full-scale IRBM nose cones of Jupiter missiles AM-5, AM-6, and AM-18 were successfully flown and recovered on May 18, 1958, July 17, 1958, and May 28, 1959, respectively. The successful recovery of the early scale version established the feasibility of the ablation concept, making it justifiable to fabricate and test full-scale cones. The specific materials used and the degree of effectiveness of these materials are still classified information.—**End**

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News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)*

October 1960

Prospects for Lexan

At the recent opening of its $11 million Lexan plant in Mt. Vernon, Ind.—with an annual capacity of over 5 million lb.—General Electric emphasized the future possibilities for polycarbonates with some startling growth figures and predictions. By 1962, the company expects the total market for polycarbonates to be between 6 and 12 million lb.; by 1965, the estimate is for 30 to 50 million lb. and by 1970, the top range anticipated is 75 to 100 million pounds. As to price, the company expects it to go to between 60 and 85¢ per lb. by 1965.

Perhaps most indicative of GE's expectations for the future is the fact that the new plant, which is located on a 162-acre site along the Ohio River, was designed so that output can be more than doubled without expanding existing physical facilities and then redoubled through plant expansion.

Several predictions were made too as to the market areas that would absorb the expected output. In addition to the more than 300 commercial applications in which Lexan is currently used, GE feels that polycarbonate resin will find increased uses in business machine housings (one complete unit molded of the material will soon be on the market), in the electrical and electronic field, and in aircraft and automotive applications. Two existing automotive applications are brake bushings and brush holders.

Moreover, several off-beat applications, including an injection molded polycarbonate dental plate to compete with compression molded acrylate plates, are currently being field tested. And the company is confident that a whole new range of applications will open up when the technique of cold forming (see MPI, Sept. 1960, p. 137) can be perfected. Just imagine the economies that can be achieved by processing polycarbonate film and sheet on conventional high-speed metal working equipment!

It should be noted that polycarbonate film is only now getting off the ground. Some film, made by solution casting, is being used by Ansco (under the trade name of Plestar) as a photographic film for military and graphic arts applications. GE has also been doing considerable work in the area of polycarbonate copolymers (based thus far on phthalic acids, glycols, high temperature polyesters, or silicone copolymers). One film, based on a copolymer construction and currently under evaluation, is a high-temperature, electrical insulating film with a craze resistance claimed to be 2 to 5 times better than the standard film and with a temperature resistance 40° C. higher than the standard. Other copolymer films are reportedly in the works including one that can be plasticized to give it drape or crystallized to improve tear resistance, solvent resistance, etc.

Polystyrene producers

There has been some confusion in the industry over the number of producers in the U. S. who actually produce polystyrene polymer direct from styrene monomer. MODERN PLASTICS has, therefore, assembled a list of companies who are actually known to be polymerizers of the monomer. There are probably producers of virgin polystyrene who are not on the list printed here, but if so, their operations have not been reported to this organization. This printed list, of course, does not include distributors of virgin polystyrene or manufacturers of reprocessed material unless the latter also produces virgin polystyrene. There are 15 companies in this distributor-reprocessor group listed in the *Modern Plastics Encyclopedia* directory. There must be at least 25 or more of these distributor-reprocessor companies who have never requested a listing in the Encyclopedia.

Atlantic Chemical Corp., Passaic, N. J.—*Molding powder division is Macromol Corp., Matawan, N. J.*

Beagle Plastic Corp., Leominster, Mass.

Cosden Petroleum Corp., Div. of W. R. Grace & Co., Big Spring, Texas.

Dow Chemical Co.,* Midland, Mich.

Foster Grant Co. Inc.,* Leominster, Mass.

Granada Co. (Rexall), Santa Ana, Calif.

Hammond Plastics, Worcester, Mass.

Koppers Co. Inc., Pittsburgh, Pa.

Massachusetts Plastics Co., Ludlow, Mass.

Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Plastics Corp. of America, Stamford, Conn. *Controlling interest owned by Richardson Co., Melrose Park, Ill. Company is outgrowth of Lincoln Plastics, Stamford.*

Polymer Products, Clark, N. J. *Entire output to Gilbert Plastics, Kenilworth, N. J.*

Seamco Chemical Co. (Rexall), Holyoke, Mass.

Shell Chemical Co., Wallingford, Conn.

Solar Plastics, Leominster, Mass. (formerly Astra)

Ticonderoga Chemical Corp., Leominster, Mass. *President of Ticonderoga is also president of Plastic Academy Products, a molding firm.*

Union Carbide Plastics Co.,* Div. of Union Carbide Corp., New York, N. Y.

To this list should be added the companies who produce ABS (acrylonitrile- **(To page 216)**

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* Less injection problems with technically-difficult moldings
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* Hydraulic piston incorporated to screw shaft solves thrust difficulties

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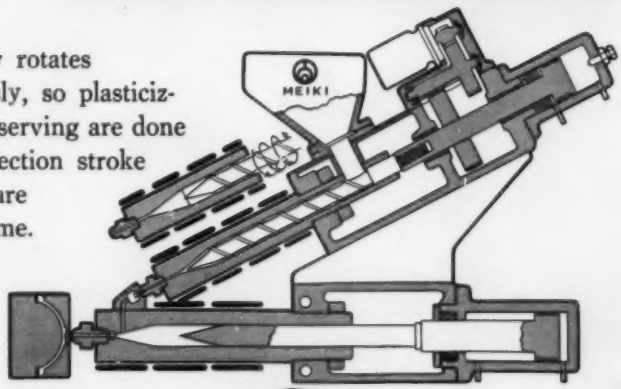

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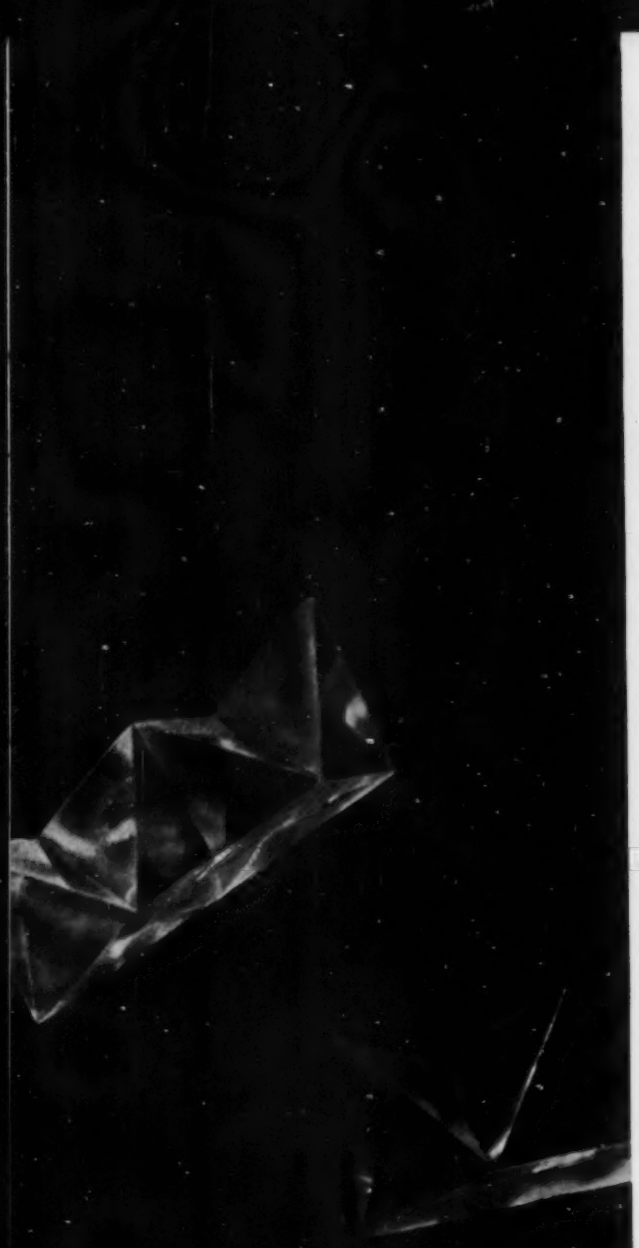

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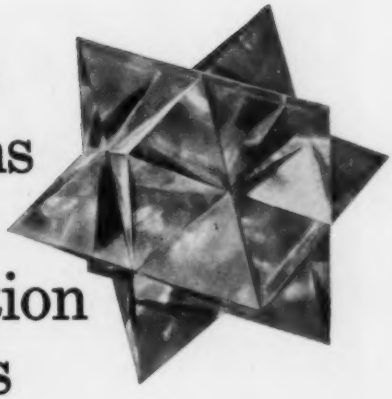


MONSANTO TECHNICAL SERVICE recently .... recommended the one cement among hundreds that solved a molder's sealing problem and cleared the way for the production of a unique plastics cream-dispensing container .... employed a revolutionary system (developed by Monsanto) for measuring styrene colors, duplicating a customer's color sample with an accuracy never before attainable .... custom-formulated a new material to deliver the desired combination of properties required in a manufacturer's newly designed end product.

These are typical of the many different jobs this department does regularly to help promote customer success. There are Monsanto Technical Service field men on constant call to unravel knotty plastics production line problems on the spot—and keep manufacturers fully informed about new materials, processes, and testing methods. The Customer Service Laboratories draw on a wealth of experience and accumulated data to evaluate specific needs. Objective material recommendations can be made because of the wide range of Monsanto products and formulations.

Molders, extruders, designers, converters, laminators, processors, manufacturers all profit today from Monsanto technical guidance in producing better looking, better operating, better selling plastic products. Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.

MONSANTO ACTIVATOR IN **PLASTICS**

Monsanto

FREE: If you would like this plastic puzzle, just ask your Monsanto Representative.

THE PLASTISCOPE

(From page 212)

butadiene - styrene) materials: Naugatuck Chemical, Marbon Corp., and B. F. Goodrich Chemical Co. The tradenames are Kralastic, Cycolac, and Abson, respectively. None of these three produce regular or high-impact polystyrene.

Those companies listed earlier with the asterisk produce ANS (acrylonitrile-styrene) materials under the names C-11, Tyril, and Fostacril in addition to regular and impact polystyrene.

Two companies, American Cyanamid and Amoco Chemicals, dropped production of polystyrene a year ago but the latter is operating a pilot plant.

Progress in Delrin

Three molded parts. Chicago Molded Products is calling attention to three recently molded Delrin parts as items that can be used to replace metal. For example, engineers at Planet Products Corp., Chicago, Ill., point out that the double sheave on Planet's general gear pumps has excellent strength, toughness, temperature resistance, low co-efficient of friction, abrasion resistance and dimensional stability.

Clayton Mark & Co., Evanston, Ill. engineers, in discussing the advantages of the fast priming tube and the volute and venturi assembly of its Mitey Mite jet pumps, say that the component in Delrin is streamlined for greater water capacity and has good heat and abrasion resistance.

Red Jacket Mfg. Co., Davenport, Iowa, states that its shallow well and deep well Trailblazer pumps include upper and lower impellers of Delrin. Both of these pumps have smooth clean surfaces for high efficiency, resist acid water, and are more abrasion resistant than brass or most similar metals.

Pipe tested. A new Delrin pipe designed for oil field service is being test-marketed in Kansas and the Tri-State Illinois Basin, according to the Du Pont Co. Among the pipe's advantages is a simple heat-fusion fastening method which yields a joint of high strength. Field tests of oil field surface line pipe were begun in 1958. The test-marketing program was based on favorable results of over 20 test installations by eight oil companies. Potential applications include flow lines, gathering lines, salt water disposal, and water flooding lines.

Du Pont will manufacture the pipe, which is covered by a patent, on the site of its Delrin facilities near Parkersburg, W. Va. Delrin combines high strength and toughness with fatigue endurance under pressure surging conditions, according to Du Pont, and has outstanding solvent resistance and dimensional stability over a wide temperature range.

Polyethylene foam

Facilities to produce polyethylene foam, one of the newest of the plastic foams, will be constructed at The Dow Chemical Co.'s Hanging Rock Plant at Ironton, Ohio, adjacent to present facilities which produce Styron and Styrofoam, Dow's polystyrene and its polystyrene foam.

The new material is trademarked Ethafoam. Early market development for Ethafoam has been in marine buoyancy applications — swimming safety belts, surf boards, boat fenders, dock bumpers, and a variety of marine toys. The foam is flexible and closed-cell and about 30 times lighter than water. The new Dow facility will cover 61,000 sq. ft. and will employ 30 to 40 people. R. P. Lowry of Dow's engineering department is project engineer for the plant. Merrill Weymouth is plant manager.

Penton sheet

Extruded Penton sheet for lining tanks, vessels, and other equipment is now available in 48-in.-wide rolls from National Vulcanized Fibre Co. These extra-wide rolls cut application costs because more surface area can be covered with a single width. This reduces the number of seams and seaming material required, cuts welding time and expense, and speeds installation. Equipment lined with Penton can be made of less-expensive materials, thus saving on initial cost. Steel tanks, for example, can be fitted with Penton linings to successfully handle highly corrosive liquids.

The use of Penton linings is reportedly a practical means of incorporating corrosion and abrasion resistance in many kinds of equipment, and is applicable both to existing equipment in the field and to new equipment during fabrication. Typical applications include linings for plating tanks, process vessels, fume hoods and ducts, large-diameter pipes, pickling tanks, vats, etc. These linings are also used in tank cars carrying corrosive fluids.

Phenolic-vulcanized fibre

An insulating material that combines the good electrical properties and mechanical strength of vulcanized fibre with the low moisture absorption of phenolic laminates has been developed by National Vulcanized Fibre Co. Known as Anilite, the material is said to have two to four times the moisture resistance of conventional vulcanized fibre. Sheets 1/16-in. thick cost 26¢/sq. ft. compared to 17¢ for commercial grade vulcanized fibre. Grade X phenolic laminates cost 39¢ for the same thickness.

Some of the expected applications include circuit breaker barriers, transformer barriers, knife switch guides, wiring devices, electrical fixture insulation, instruments and control panels and magnetic coil heads.

Tinopal PGP

In 1956 The Geigy Co. Ltd. of England introduced Tinopal PCRP, a heat- and light-stable optical brightening agent for plastics. Tinopal PCRP is characterized by a reddish blue fluorescence, and for some applications requests arose for a product with the same heat and light stability as Tinopal PCRP but with a greenish blue fluorescence. Research by Geigy has now led to the production of Tinopal PGP, which has the desired greenish blue fluorescence. This is of particular advantage **(To page 218)**

...with R/M Style 41RPD asbestos-phenolic felts

Motor-tube insulation liners and other high-temperature asbestos-phenolic parts are natural applications for R/M Pyrotex® felts and tapes.

Wrapped by a variety of techniques, tubes of R/M Style 41RPD Pyrotex tape can be fabricated into one-piece (no joints) ablation-resistant parts capable of withstanding extreme high temperatures for periods of 60-90 seconds.

Extra-long spinning-grade asbestos fiber provides the unusual physical stamina in parts made from R/M Pyrotex felts. High strength-to-weight ratio and excellent percentage retention of physical properties after exposure to high temperatures are additional advantages of such parts.

R/M Pyrotex felts are easy to handle. Readily available from coaters or from R/M. Write for complete information.

RAYBESTOS-MANHATTAN, INC.

Reinforced Plastics Department, Manheim, Pa.

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

THE PLASTISCOPE

(From page 216)

when, for example, anatase titanium dioxide is used to produce the purest white possible in polyvinyl chloride, polystyrene, or cellulose acetate.

With regard to light fastness, the limiting factor is, of course, the type of plastic used, and the light fastness is especially high in the following: polyvinyl chloride, polystyrene, polyethylene, and cellulose acetate. Tinopal PGP has only moderate light-fastness in polyester resins and polymethylmethacrylate resins.

Rexall operations

Production of a wide range of polyethylene film for agricultural, industrial, and general uses at Santa Ana Film, Div. of Rexall Drug & Chemical Co., has been announced by Charles Farrell, general manager. The firm is located at 402 W. Central Ave., Santa Ana, Calif., and is one of several Rexall plastics operations located at its Santa Ana plant. George G. March, formerly plant manager of the Kraloy Plastic Pipe Co., a Rexall subsidiary, is plant manager. Charles A. Blackburn Jr., formerly with Rexall Drug Co. in Los Angeles, and William H. West, recently with the Chippewa Plastics Co., another subsidiary, are sales representatives.

Robert E. Burrough has been appointed personnel manager for the Odessa, Texas operations of Rexall Chemical Co. division, which will produce and market petrochemicals in conjunction with El Paso Natural Gas Products in Odessa. El Paso Natural Gas Products Co. will be concerned with the hydrocarbons and olefin plants, while Rexall Chemical will handle the polymer and chemical plant operations.

PE netting

A 36-in.-wide flat polyethylene netting has been added to the line of Naltex extruded thermoplastic netting now available from Nalle Plastics Inc., Austin, Texas. The netting has a selvage edge, a diamond mesh size of 1 by 1⅝ in., weighs 2.5 oz./sq. yd., comes in red, blue, yellow, green, and natural colors, and is packaged in approximately 100-ft. rolls. List price is $1.40/lb.

The company states that its technique will soon permit the replacement of monofilaments with hollow tubes when desired for such applications as carpet padding, heat exchangers for corrosive liquids, and other uses.

Whitehouse-Lunn merger

An agreement to merge through an exchange of stock has been announced by Whitehouse Plastics Corp., Fort Worth, Texas manufacturer of plastics boats, and Lunn Laminates Inc., Huntington, N. Y. manufacturer of plastics boats as well as other plastics products. Mr. Lunn will continue to manage the Lunn Company as a division of Whitehouse. Under the terms of the merger, 732,275 shares of Whitehouse stock would be exchanged for the currently outstanding 813,639 shares of Lunn Laminates stock.

Whitehouse Plastics sales for the year ending Oct. 31, 1959 amounted to $3,788,000, and for the six months ended April 30, 1960 were $2,950,000. Lunn Laminates sales for the first six months of 1960 were $1.1 million.

Flame retardant varnish

A phenolic varnish, designated Resinox 495, and recommended for printed circuits used for commercial radio and TV applications and as copper clad laminates for electronic computers and military applications, has been developed by Monsanto Chemical Co.'s Plastics Div. According to the company, paper-based industrial laminates impregnated with the new phenolic varnish meet the electrical, physical, and mechanical standards of NEMA and UL test for flame resistance.

In the meantime, price increases for all Resinox phenol-formaldehyde liquid and solid resins and adhesives have been announced by Monsanto's Plastics Div. The increases range from ¼ to 1½¢/lb. and are effective October 1, 1960. Chester L. Jones, resin products director of sales, said that the ¼¢ increase will apply to the standard 40% solids adhesives used to manufacture fir plywood. The 1½¢ increase will affect powdered resins used in the foundry and abrasives industries. Corresponding increases were announced for more than 75 other special formulations which make up the product group.

The price increases followed a rise in the price of phenol, and also reflect increases in the prices of other raw materials, as well as transportation and labor costs.

Diamond dedication

More than 300 local and state dignitaries, customers, suppliers, and other invited guests attended the open house and plant dedication of Diamond Plastics Industries Inc., Roanoke, Va., one of the country's largest manufacturers of rigid plastic containers.

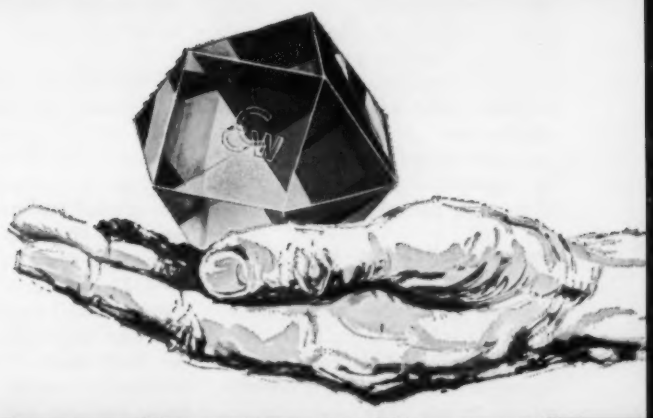
Diamond Plastics Industries was acquired early this year by Paper Package Co., an affiliate of Eli Lilly & Co., Indianapolis, Ind. Originally formed as Hake Mfg. Co. in Depew, N. Y. in 1945, the firm moved to Roanoke in 1954. From 111 employees in 1955, the company has grown to a current total of 280 employees.

The company does business primarily in the packaging field. It produces more than 125 different sizes of rigid, hinged, transparent, and various colored boxes for a variety of markets, ranging from fishing tackle to pharmaceuticals. The 1960 Olympic Games medals were packaged in Diamond boxes.

Solid urethane

A new family of solid urethanes that can be compounded to customer specifications in roll, sheet, tube, rod, and cast parts for a variety of industrial applications has been introduced by Armstrong Cork Co.'s Industrial Div. For example, tensile strength and abrasion resistance can be combined, on a reproducible basis, with elasticity and resilience in degrees to fit individual needs. This material replaces metal, ceramics, rubber, **(To page 220)**

A COMPANY
WITH MANY
FACETS TO
BETTER SERVE
INDUSTRY



Stabilizers and Plasticizers
for Vinyl Plastics

ADVANCE
SOLVENTS & CHEMICAL
New Brunswick, New Jersey

Division of

CARLISLE
CHEMICAL WORKS, INC.
Reading, Ohio

THE PLASTISCOPE

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and other traditional materials in chute linings, jack hammer buffers, vibration pads, diaphragms, gaskets, belts, etc. Some of the formulations are said to be hard enough to be used for lawnmower blades which outlast tempered steel, and flexible enough to be used for vacuum cleaner belts that outwear any material previously used.

Armstrong urethane reportedly provided a service life 50 to 100 times greater than previously used material for the valve insert flange of an oil well pump. In jar capping machinery, urethane's combination of resilience, high resistance to friction and abrasion meets the need for parts which will both handle the caps gently and resist wearing while producing a tight seal.

A new urethane and fluorocarbon sales department has been created in the Industrial Div. Ralph M. Hill has been appointed manager and will assume full responsibility for the sale of Accopacs fluorocarbon sheet materials primarily designed for gasketing and several industrial applications. J. A. Kelly was named technical assistant and will be responsible for the promotion of cast urethanes.

Increase in maleic

Monsanto Chemical Co. has increased its production capacity of maleic anhydride by 20 million lb.; its potential output of the versatile resin material is now 60 million lb. per year.

Dr. John R. Durland, product director for resin materials in Monsanto's Organic Chemicals Div., estimates that current production of maleic anhydride in the U. S. is at a rate of 85 million lb. for the year. This indicates an increase of 63% over the 52 million lb. produced in 1958. Polyester resins for reinforced plastics boats, trailer and truck bodies, and materials for the construction industry account for approximately 30% of current maleic anhydride consumption, according to Dr. Durland. Alkyd and vinyl-based surface coatings account for another 30% of the resin materials market, which also finds uses in agricultural chemicals, petroleum additives and as an intermediate.

New plastic-clad metal

Two laminates, one using Teslar polyvinyl fluoride film, the other using Videne, a film developed by DiNoc Co., Cleveland, Ohio, from Goodyear material, have been added to the line of vinyl-metal laminates produced by the Arvinyl Div. of Arvin Industries Inc., Columbus, Ind.

Teslar, processed in 2-, 3-, and 4-mil thicknesses, and in clear, glossy, and pigmented types, is suggested in laminates for billboard trim, building siding, prefabricated panels, ductwork, roofing, and gutters. Videne, a 2-mil film supplied in wood and marble grains and colors, is expected to be widely used in laminates for television cabinets, canisters, refrigerator panels, and a variety of carrying cases.

Adhesives for vinyl walls

Three new resin adhesives for the vinyl wall covering market have been introduced by National Adhesives Div., National Starch & Chemical Corp. under the designation V-W-C: 31-7500 is a liquid adhesive for cloth-backed vinyls; 18-0523, a liquid adhesive for paper-backed vinyls; and 53-9100, a water dispersible dry adhesive for cloth-backed vinyls. All are claimed to exhibit high freeze-thaw stability and strong adhesion to many types of building surfaces including sized and unsized plaster, plywood, cement, cinder block, plaster board, etc.

RP paneling

A continuous, cross-corrugated, translucent, fibrous glass-reinforced plastic paneling in roll form has been developed by Filon Plastics Corp., Hawthorne, Calif. The new material, tradenamed Rololite, reportedly will improve and speed installation of long industrial skylights, sidelights, and awnings. Stocked in 50-ft. rolls, 40 in. wide, and in 2½ by 9/16-in. corrugation, with crinkle finish on both sides, it is available in colors in two weights: 5 oz./sq. ft. (Type 550), and 8 oz./sq. ft. (Type 850).

Sohio's acrylonitrile

A spokesman for the Standard Oil Co. (Sohio), which is producing acrylonitrile for synthetic rubber and plastics by a new process, said that the product has an "important future" and the new process "is expected to become an important factor in future production. Acrylonitrile has been manufactured by other processes for several years but the new process is based on a single-step, direct conversion of propylene, ammonia and air developed by Sohio.

The production of acrylonitrile has increased from almost nothing to 200 million lb. annually in 10 years and is expected to exceed 400 million lb. by 1965, according to the company.

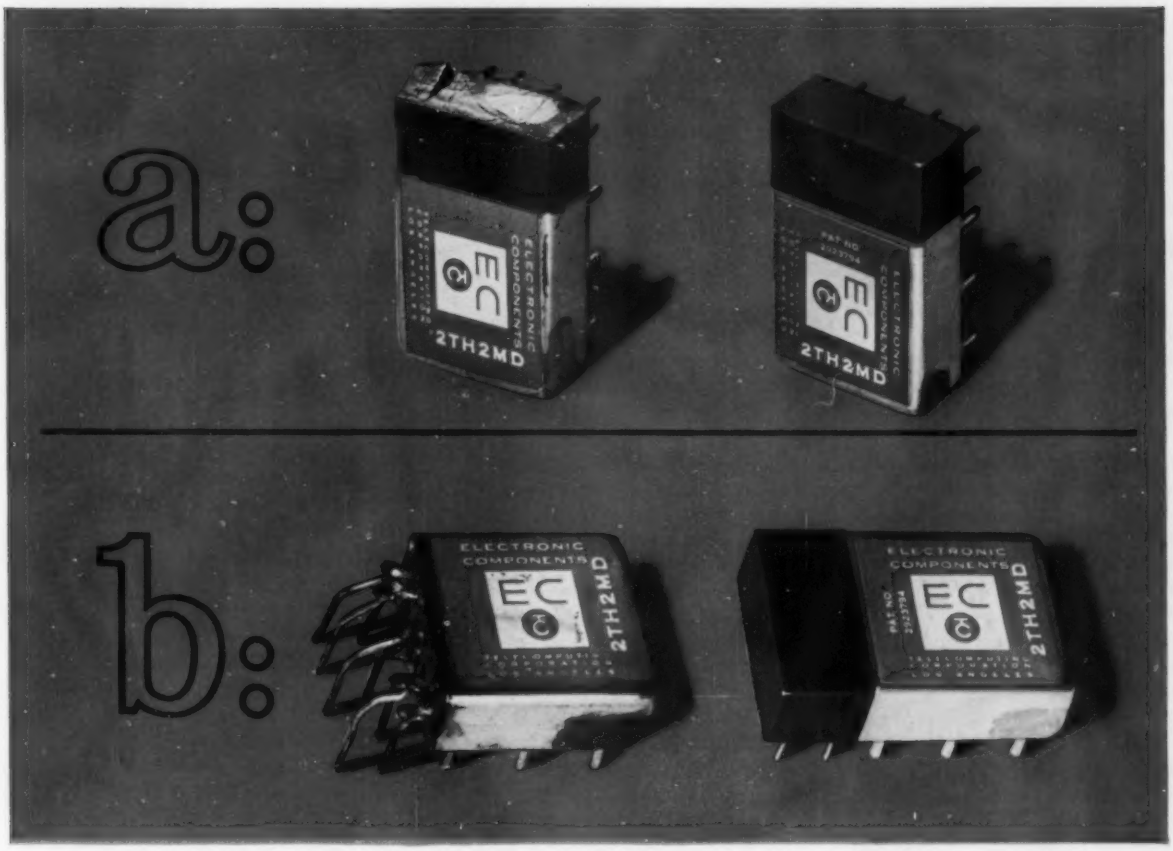
Rigid urethane foam

A rigid urethane foam system employing polyether resins has been announced by Commercial Resins Corp., St. Paul, Minn. The users need only mix two packages for a 2-lb. density foam and thus eliminate addition of other ingredients. The packages contain PEF-2000 and PEF-2003, a polyether resin prepolymer and a catalyst propellant mixture, respectively. The propellant is trichlorofluoromethane.

The foams produced are closed-cell, suitable for flotation, insulation for buildings and boats, or packaging material. They can be foamed-in-place. Adhesion to most surfaces is excellent, but release can be obtained if desired by using silicones, waxes, or Teflon. Color pastes can be used if desired.

The company has also added several polyesters to its line, including CoRezyn 1, a solid unsaturated rigid orthophthalic polyester without styrene. This is packaged in a solid lump weighing 100 lb. which can be easily pulverized and styrene monomer added for use in increasing viscosity of other polyesters, and as binders for patching **(To page 222)**

DOW | **THERMOSETTING RESINS**



TESTS PROVE DOW EPOXY NOVOLAC

outperforms conventional epoxies under extreme stress!

Potting relay terminal connectors for the guidance system of one of America's new missiles, a major electronic component manufacturer made a series of torture tests . . .

TEST a: To determine the effects of prolonged heat on two terminal relay potting formulations—one a high quality conventional epoxy resin, the other, Dow Epoxy Novolac (D.E.N. 438). Both were placed in a 180°C. oven. After five hours, the conventional epoxy resin potting cracked. But after 100 hours of continuous 180°C. heat, the potted terminal made from Dow Epoxy Novolac was unharmed!

TEST b: To compare the ability of each potting to withstand the action of high-powered degreasing solvents. The ordinary epoxy resin formulation was completely dissolved after only 48 hours in the stripper. But the potting made from D.E.N. 438 showed no significant change, even after two weeks' immersion in the same solvent!

RESULTS: Proof once again that for potting, molding, encapsulating, laminating electronic components, or for any application where performance is critical, Dow Epoxy Novolac resins can provide the extra measure of physical and chemical stability necessary for success.

New applications for the Dow family of thermosetting polymers are being uncovered every day. If your application could benefit from their hardness, toughness, dimensional stability, and chemical resistance, call your nearest Dow sales office. Or write: THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Merchandising Department 1966CS10.

See "The Dow Hour of Great Mysteries" on TV

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

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compounds, etc. CoRezyn No. 2 is a solid isophthalic polyester resin especially suggested for boats. No. 3 is another unsaturated polyester without styrene for patching and to add to rigid resins for impact.

Du Pont sets up polyolefins div.

Formation of a separate division to concentrate on marketing, production, and research and development effort in the field of polyolefin plastics has been announced by Du Pont's Polychemicals Dept.

Roy L. Schuyler, assistant director of sales for the department, has been appointed director of the Polyolefin Division. He has been with Du Pont since 1937, and has been manager of the Victoria, Texas plant and assistant production manager of the Polychemicals Dept. in recent years. Other appointments in the new division are: Herbert S. Lecky, manager of marketing. Dr. Lecky joined Du Pont in 1941 and has been product manager for Alathon polyethylene resin for several years. Bailey H. Barnes, field sales manager. He joined Du Pont in 1939, has been in sales work since 1951, and was most recently assistant manager for plastics resin sales. J. M. Nelson, manager of research. He joined Du Pont in 1949 and has been a product manager in the Manufacturing Div. since 1958. Daniel E. Strain, associate research manager. Dr. Strain came to Du Pont in 1929 and has been associated with research and development work in polyolefins since 1948. Peter M. Alexander, manager of manufacturing, joined Du Pont in 1948. He has held supervisory posts at various plants operated by the Polychemicals Dept.

Uses for epoxy resins

End-uses for the family of Oxiron epoxy resins introduced earlier this year by Food Machinery & Chemical Corp. are being explored by a newly formed application group at the company's research and development center at Princeton, N. J. Because these materials are epoxidized polyolefins, rather than epichlorohydrin bisphenol condensates, they are capable of reacting in many ways and hold promise for a wide range of uses. They not only differ from conventional epoxies in molecular structure and reactivity but also exhibit more varied end-properties.

The new group is investigating these resins for use in prepregs as well as for wet layup applications. The materials show potential in this area because of their high strength-to-weight ratio, excellent adhesion to glass fibers, fast cure cycles, and cost advantages for formulations. Work is underway to achieve a stable B-stage for them. Studies are being conducted on applications where high costs previously have excluded epoxies. Cost advantages of Oxiron resins result from the use of higher proportions of relatively low-priced reactants, and their lighter weight gives greater volume per pound than conventional epoxy resins.

The unusual curing characteristics of the resins appear to suit them well for casting applications. They exhibit low shrinking and low exotherm on cure. High temperature studies of the materials indicate possibilities with regard to mechanical strength and electrical properties.

Dow associate to build PE plant

A proposal has been placed before the Japanese government by Asahi-Dow Ltd., an associated company of The Dow Chemical Co., for the construction of a polyethylene plant at Kawasaki, Japan. According to the proposal, the new plant would use the high-pressure polyethylene process developed by Aktiengesellschaft für Olefin-Polymerisation (AGFO). Since the proposal also includes the use of Dow know-how in the fields of PE manufacture and fabrication, Asahi-Dow has been able to present a fully integrated proposal to the Japanese government. Asahi-Dow manufactures styrene, polystyrene, and saran at plants in Kawasaki, Nobeoka and Suzuka City using Dow technology.

Organophosphites

Production of triphenyl phosphite, diphenyldecyl phosphite, phenyldidecyl phosphite, and tridecyl phosphite on a full-scale commercial basis to meet growing demands for these chemicals in the plastics, paint, and chemical processing industries is announced by the Eastern Chemical Div. of Hooker Chemical Corp., Niagara Falls, N. Y.

These organophosphites are useful as ingredients in stabilizer systems for polyvinyl and polyolefin resins. Another important application is the use of triphenyl and decylphenyl phosphites during the "cook" to improve clarity and color of alkyd resins.

Polyethylene for rough handling

A new, high-impact polyethylene film formulated to overcome rough handling breakage in free-flow pouch packaging operations has been announced by Western-Waxide Div., Crown Zellerbach Corp. According to Karl Wuestenfeld, manager, frozen food packaging, "this new chill-cast film not only overcomes present breakage problems but also possesses a low melt index which enables tight seals through a greater temperature range."

Extensive testing is claimed to have shown that the exceptional toughness of the new formulation resists fracture from impact shocks received in transit or in-store. The single-layer PE pouch must resist the same buffeting as conventional two-layer carton and overwrap packages.

Pilot plant for new products

A new pilot plant in Akron, Ohio, which will be devoted to plastics product development has been set up by General Tire & Rubber Co. Differing from many similar operations, General Tire's pilot plant is devoted exclusively to product development and many of its requests for new products come directly from the plastic-using industries. Oftentimes the laboratory will discover a new product, so that a **(To page 224)**

Trouble-free performance for vinyl gaskets

Vinyls plasticized with PARAPLEX G-54 are exceptionally well suited for many types of gaskets—especially for those on refrigerator and freezer doors, boat windshields, and air-conditioner panels.

Here are some performance properties PARAPLEX G-54 gives to your compounds: (1) Exceptional compatibility between plasticizer and vinyl resin—even at the high plasticizer concentrations required for soft gaskets. (2) Excellent resistance to plasticizer migration into lacquers, baked enamels, polystyrene, and acrylic plastics . . . protects against marring of finishes and crazing of plastics. (3) Low odor. (4) High resistance to plasticizer extraction by soapy water and food oils and greases. (5) Good resilience properties. (6) Exceptional plasticizer compatibility in stocks containing both PARAPLEX G-54 and PARAPLEX G-62. The latter is an epoxy plasticizer frequently used with PARAPLEX G-54 to provide heat and light stabilization.

You'll find PARAPLEX G-54 particularly valuable for compounds requiring exposure to high humidity and elevated temperatures. Under such conditions, vinyls plasticized with PARAPLEX G-54 show good resistance to plasticizer exudation. Write for technical literature on PARAPLEX G-54. Also inquire about our complete line of PARAPLEX and MONOPLEX plasticizers.

PARAPLEX *and* MONOPLEX *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

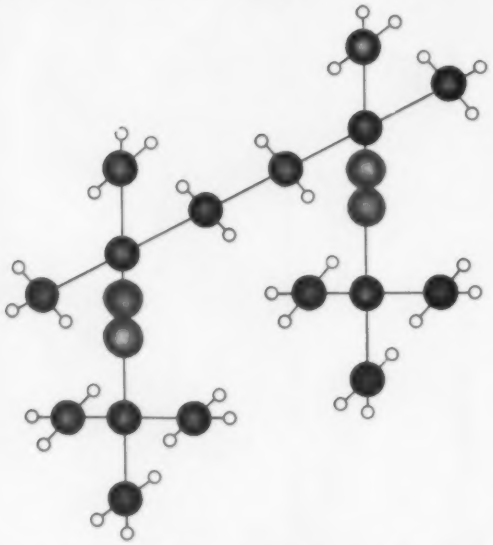
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

PARAPLEX G-54

LUPERSOL 101



2,5-dimethyl-2,5-di (t-butylperoxy) hexane

LUPERSOL® 101 is a stable, liquid, high temperature difunctional peroxy compound with low volatility and high purity. It offers advantages of economy and performance in:

1. Polyethylene Cross-linking. Processing at high temperature (up to 270°F) with normal techniques. No noxious by-products.
2. Styrene Polymerization. Higher molecular weights. Broader molecular weight distribution. Use **5 to 10 times less** than conventional catalysts.
3. Polyester Resins. Obtain longer shelf life. Use higher processing temperatures. Use **4 times less** than conventional catalysts.

Half-Life in Benzene

240°F	16.7 hrs.
266°F	2.8 hrs.
300°F	0.26 hrs.

Properties

Active Oxygen	10.5% min.
Boiling Point	50-52°C @ 0.1 mm. Hg.
Vapor Pressure	65°C @ 0.71 mm. Hg.
	50°C @ 0.39 mm. Hg.

Write for Data Sheet

LUCIDOL DIVISION

WALLACE & TIERNAN INCORPORATED
1740 MILITARY ROAD
BUFFALO 5, NEW YORK

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(From page 222)

finished prototype is developed and then taken to the industry concerned for its consideration. The laboratory serves to coordinate the work of all processing, including vinyl chloride, rigid foam, and reinforced plastics.

Nylon electric shaver

The first electric shaver to be housed in nylon has been introduced nationally by Schick Inc. Foster Grant Co. Inc., Leominster, Mass., which supplies the nylon 6 molding compounds, cooperated with other molders in the engineering of the molds and development of fabricating techniques. According to J. J. Kelly, Foster Grant's plastics sales mgr., the new Schick 10-66 introduces nylon into a new major field of use and should trigger a wider use of the material in consumer products. One of the first uses of nylon in a consumer product was for frames of sunglasses manufactured by Foster Grant.

Polyflex trays

A new transparent rectangular tray that gives six-sided product visibility is being produced by Container Corp. of America, Chicago, Ill. Tradenamed Plasti-Lok, the tray can be used, with or without overwrap, for various products, including food, and is said to have FDA approval.

Developed by Charles Palmer & Assocs., Somers, Conn., the trays are made from biaxially-oriented polystyrene called Polyflex. Container Corp. manufactures die-cut blanks, either printed or plain. The blanks are then cold formed and locked at the customers' plants using a high-speed machine manufactured by R. A. Jones Co., Covington, Ky.

Stabilizer for plastisols

A modified barium-cadmium-zinc liquid stabilizer, identified as 6-V-6A, has been developed by The Harshaw Chemical Co., Cleveland, Ohio. The new stabilizer for vinyl plastisols and organosols is said to incorporate significant improvements in heat, light and weather **(To page 226)**

Remarkable present . . . amazing future!

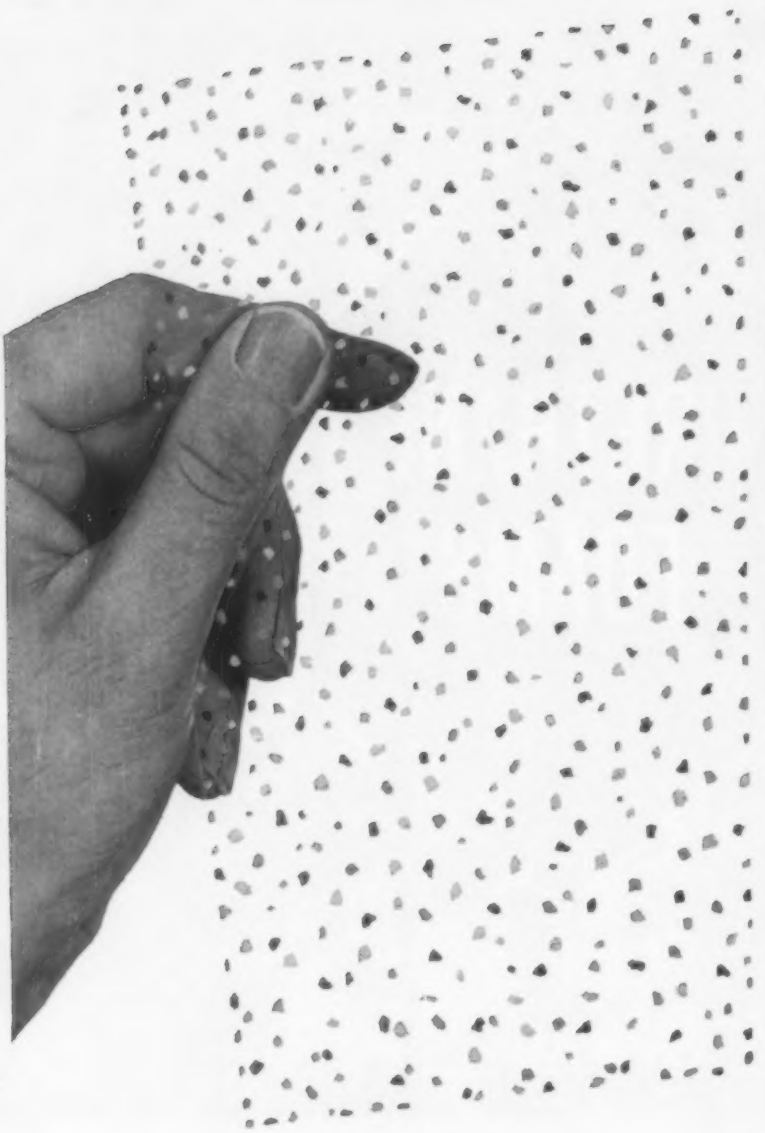
Flexible urethane foams alone are sure to pass the 100-million-pound mark in 1960. And they are only a part of the story. What limits can you place on materials that cut 8½ tons from an atomic submarine's weight; protect missile components against heat damage to 6000° F.; are preferred by jet aircraft and automobile manufacturers for insulation and cushioning; make foam mattresses as economical as innersprings; promise 20-year house paints and 100,000-mile-tread automobile tires?

Jefferson offers new polyethers made to rigid urethane specifications with emphasis on low unsaturation, low water content, low ash, low acid numbers, and controlled pH. Also available are excellent catalysts for flexible, semi-rigid and rigid urethane foams . . . N-methylmorpholine, N-ethylmorpholine, and the interesting amine, N, N′-dimethylpiperazine. For a partner in developing better urethane products, contact . . . Jefferson Chemical Company, Inc., 1121 Walker Avenue, P. O. Box 303, Houston 1, Texas.

Ethylene and Propylene Oxides, Glycols, Dichlorides, Carbonates
SURFONIC® Surface-Active Agents • Ethanolamines • Morpholine
N-Alkyl Morpholines • Polyethylene and Polypropylene Glycols
Piperazine • Piperazine Salts • Nonyl Phenol • Caustic Soda
HOUSTON • NEW YORK • CHICAGO • CLEVELAND • CHARLOTTE • LOS ANGELES

JEFFERSON CHEMICALS

049



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In a Paterson Overlay Paper you can't see the paper. You *can* see the attractive metal-fleck pattern . . . and that's all you can see after the paper is saturated with laminating resin.

The disappearing act is consistently dependable in any Paterson Overlay Paper. Near-sterile plant operating conditions, strict pulp control and Paterson water filtration techniques help make the difference between any of these papers and paper produced anywhere else.

Paterson Overlay Papers are available in the plain whitest white of any such papers—or with decorative metallic and colored plastic additives. Either way, the paper transforms to a transparent surface that resists heat, wear and abrasion.

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BRISTOL, PENNSYLVANIA

Sales Offices: New York, Chicago • West Coast Plant: Sunnyvale, Cal.

THE PLASTISCOPE

(From page 224)

stability, economy, and performance. Harshaw claims that vinyl compounders using stabilizers costing around $3/lb. can now achieve the same high performance with the new stabilizer for less than half the cost. Compounds calling for 3 to 5% of ordinary stabilizer can achieve equal performance with 2 to 3% of 6-V-6A, the company claims.

Polypropylene fibers

The first major market to really crack open for polypropylene has been fibers and monofilaments—and from all indications, it is still growing. According to a recent report by Dawbarn Bros. Inc., Waynesboro, Va., one of the pioneers in the production of polypropylene fibers, here are some of the immediate areas of use:

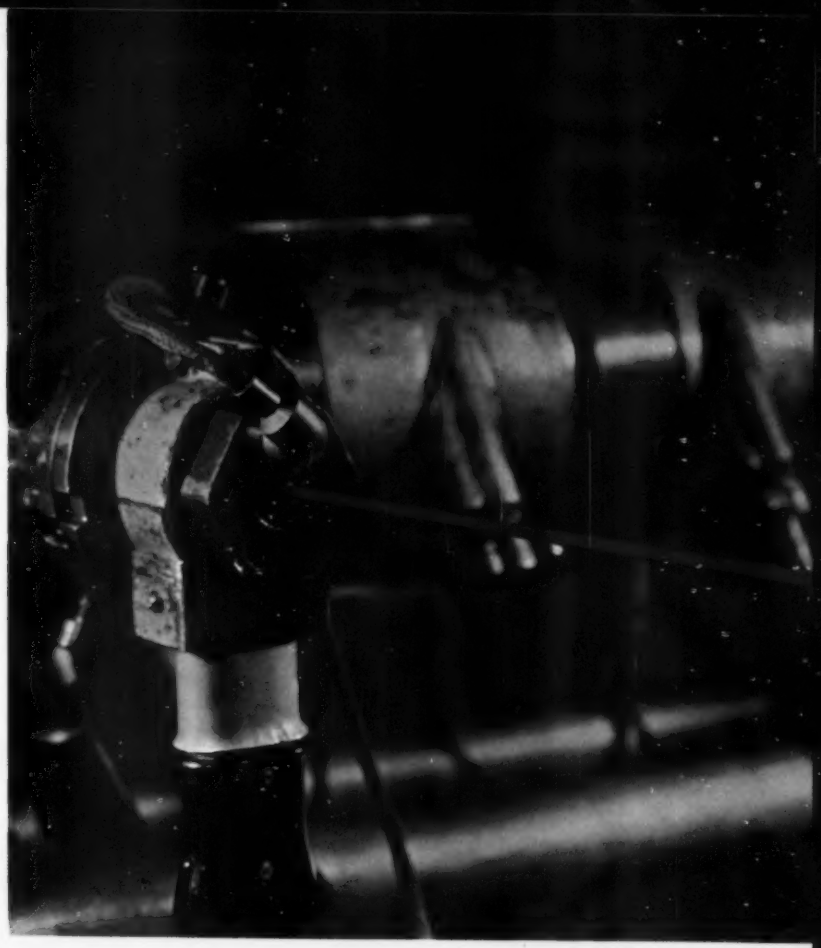
Webbing for outdoor furniture (about 140 million yd. of webbing of all types will probably be sold this year) appears to be a good bet for polypropylene. Its cost (at approximately 4¢/yd.) is one major advantage (polypropylene's yield is about 40 yd. to the pound); its good recovery characteristics and resistance to fading are other advantages. Replacement seat covers, filter fabrics, seat cushions, and swimming pool covers are also possibilities.

In the rope market (which will probably take some 18 million lb. of synthetic resins of all types this year), polypropylene is a natural. It offers stress-strain characteristics at costs lower than that of manila; its service life is two to four times that of manila; it is extremely light in weight, resists rotting by marine organisms and will not become stiff in sub-freezing weather.

There are also a number of novelty goods for which the fibers appear useful, including: shoe fabrics and goring; glasses and brief case fabrics; doll's and mannequin's hair; grille fabrics for radio, TV, etc.; wall covering; and decorative cords.

Flame-retardant laminate

A glass-epoxy laminate suitable for printed circuit and other electronic uses has **(To page 229)**



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providing excellent fastness to
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perfect electrical resistivity

economy

CIBA Company Inc.
Pigments Division
Fair Lawn, New Jersey

(From page 226)

been introduced by Synthane Corp., Oaks, Pa. Designated Grade FR-4, the material is the fourth in a series of flame-retardant compositions developed by the company, and is said to have high mechanical strength at room temperature, and good dielectric loss and dielectric breakdown properties under both dry and humid conditions. Grade FR-4 can be furnished with copper cladding on one or both sides in standard foil thickness, and is available in a wide variety of sheets, rods, and tubes.

New companies

Luma Industries Co., 330 Pleasant St., Petaluma, Calif., was formed by **Philip J. Blanchett** and **Orwin G. Maxson,** both formerly with the Dow Chemical Co. The company is an extruder and formulator of molding compounds.

Erie County Plastics Corp., Box 394, Corry, Pa., is a new injection molding firm headed by **Paul C. Roche,** president and treasurer, and **William P. Hayes,** vice-president and plant manager, both formerly with Nosco Plastics Corp. The firm will specialize in molding the new thermoplastics, including Delrin, Lexan, polypropylene, and nylon.

Howard Plastics Co. Inc. was formed as a wholly-owned subsidiary of **Dennison Mfg. Co.,** Framingham, Mass. Howard Plastics Co. purchased the land, building, and injection molding equipment of **D & D Industries Inc.,** 251 Florence St., Leominster, Mass., and will manufacture and distribute injection and blow molded products.

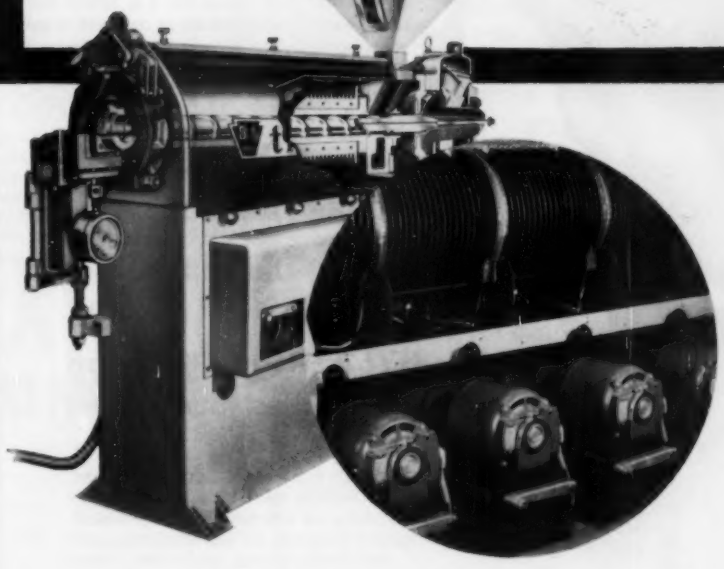
Northern Plastic Sales Inc., 410 S. Main St., North Syracuse, N. Y., was formed by **Harold S. Tyner Jr.,** president, and will specialize in extrusion, fabricating and molding of nylon, Kel-F, Teflon, and Delrin.

Crest-Foam Corp., 132-34 32nd Ave., Flushing 54, N. Y., was established by **Irving Rifkin,** formerly sales mgr. **(To page 230)**

SOONER OR LATER

BLOW MOLDERS WILL NEED thermatic*

COOLING CAPACITY



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Suppose you run linear polyethylene of low melt indices from .2 to .4 . . .

D-S Thermatic cooling capacity permits lower stock temperature of the extruded tube for faster mold cycles.

On dry color blending–a competitive necessity–high screw speed for compounding is unlimited by temperature control problems due to the cooling capacity of the D-S Thermatic.

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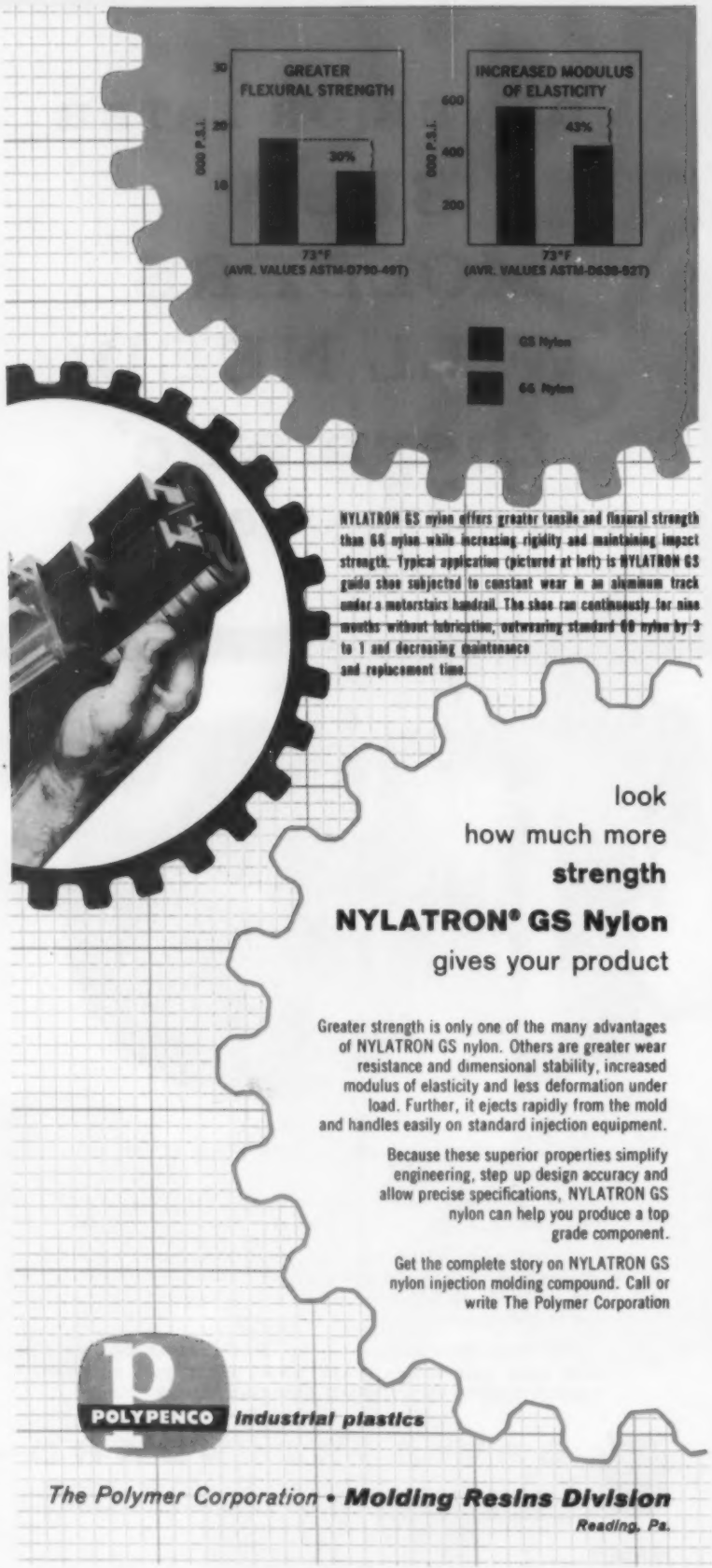
GREATER FLEXURAL STRENGTH
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30
20
10
30%
73°F
(AVR. VALUES ASTM-D790-49T)
INCREASED MODULUS OF ELASTICITY
000 P.S.I.
600
400
200
43%
73°F
(AVR. VALUES ASTM-D638-52T)
GS Nylon
66 Nylon
NYLATRON GS nylon offers greater tensile and flexural strength than 66 nylon while increasing rigidity and maintaining impact strength. Typical application (pictured at left) is NYLATRON GS guide shoe subjected to constant wear in an aluminum track under a motorstairs handrail. The shoe ran continuously for nine months without lubrication, outwearing standard 66 nylon by 3 to 1 and decreasing maintenance and replacement time.
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how much more
strength
NYLATRON® GS Nylon
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Greater strength is only one of the many advantages of NYLATRON GS nylon. Others are greater wear resistance and dimensional stability, increased modulus of elasticity and less deformation under load. Further, it ejects rapidly from the mold and handles easily on standard injection equipment.
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Get the complete story on NYLATRON GS nylon injection molding compound. Call or write The Polymer Corporation
POLYPENCO industrial plastics
The Polymer Corporation • Molding Resins Division
Reading, Pa.

THE PLASTISCOPE

(From page 229)

of Sommers Plastic Products Co. The new company produces urethane foam in continuous rolls.

Expansion

Monsanto Chemical Co. has acquired approximately 650 acres of land in Gloucester County, N. J., for development as a diversified plant site. Construction of a multi-million dollar installation to produce phthalic anhydride and phthalate ester plasticizers will start there immediately, with completion of units scheduled for early in 1962.

Monsanto also plans early construction of a new phthalate ester production facility to be located at Long Beach, Calif.

Reeves Brothers Inc., textile manufacturer, and **Curtiss-Wright Corp.,** maker of Curon foam, have announced the acquisition by Reeves of all manufacturing, laminating and sales operations relating to Curon urethane foam for all markets. In the near future Reeves Brothers plans to move the entire Curtiss-Wright foam-making operation from Quehanna, Pa., to a Southern location convenient to the furniture and carpeting industry. Reeves present laminating plant in Garfield, N. J., will be expanded and additional laminating facilities are being considered.

Cosden Petroleum Corp., subsidiary of **W. R. Grace & Co.,** has moved into the final third of its current expansion program with the erection of a 159-ft., 300,000-lb. styrene recovery column at its refinery in Big Spring, Texas. The column was literally inched into position beside the styrene unit's quadrangle of 200-ft. ultra-fractionating towers. They form the nucleus of Cosden's "styrene from gasoline" plant completed in February 1957.

The Clark-Schwebel Fiber Glass Corp. has started construction of a $3 million fibrous glass weaving and finishing plant in Anderson, S. C. The initial one-story building covering 160,000 **(To page 232)**

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PEARL PIGMENTS

FOR COMPOUNDING INTO

- POLYETHYLENE
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- VINYL
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- NITRATE
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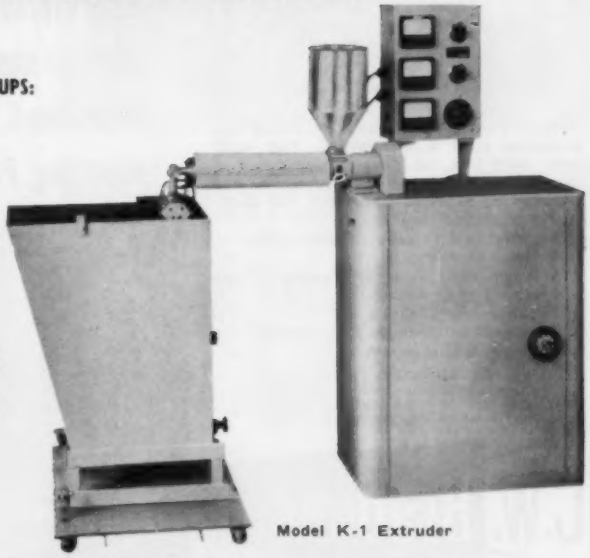

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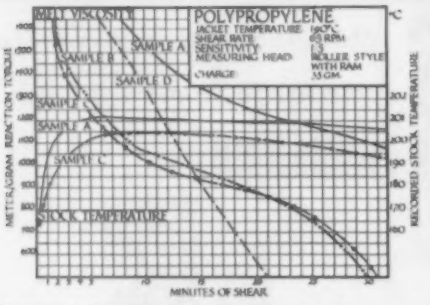

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52 E. Wesley St., Diamond 3-8425
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THE PLASTISCOPE

(From page 230)

sq. ft. on a 20-acre tract, will include a research and development laboratory, a plastics engineering laboratory, as well as a custom-built finishing plant, and is expected to employ approximately 300 people. Completion is expected by January, 1961. The company, an independent affiliate of **M. Lowenstein & Sons Inc.**, will weave and finish both industrial and decorative fibrous glass fabrics for use in aircraft, boat, roofing, electrical insulation and textile industries.

Sun Chemical Corp. has acquired two manufacturing companies and formed a new operating group to produce packaging materials as well as laminated and foam plastic products. The two acquisitions are **Dyna-Foam Corp.**, Ellenville, N. Y., and **Artistic Mfg. Co.**, Stamford, Conn. Dyna-Foam produces extruded polystyrene foam in film form for a variety of industrial applications. Artistic produces decorative packaging materials and sells to more than 15,000 retail outlets.

Artistic and Dyna-Foam will be integrated with Facile and Electro-Tech Divs. of Sun to form a new management unit designated Packaging Materials Group. The new group will be headed by **Eugene Jacobson**, newly elected VP of Sun and head of the Facile Div. since its purchase by Sun in November 1959. The Facile division does laminating of various materials to produce such products as tapes, furniture upholstery, packaging materials, etc.

Joseph Y. Resnick will continue as head of Dyna-Foam. **Julian S. Coleman** remains head of Artistic. Both will report to Mr. Jacobson.

B. F. Goodrich Chemical Co. has announced plans to construct a factory in Colombia, South America, for the manufacture of vinyl plastic materials in cooperation with Colombian participants. A new company has been organized for this purpose. The plant will be located adjacent to the factory of **Planta Colombiana De Soda** at Zipaquira. This fac- **(To page 235)**

Finish Plastic Products *AUTOMATICALLY*—With Either One or Both of These

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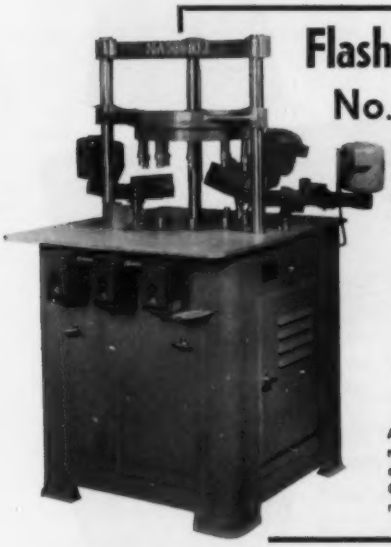
Rotary Finishers



Flash Lathe No. 103

An automatic multi-spindle Rotary Finisher that performs ALL these operations:

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Accommodates circular moldings up to 4½" in diameter, 8" in height. Continuous and intermittent operation.

Remove FLASH *Faster . . .*

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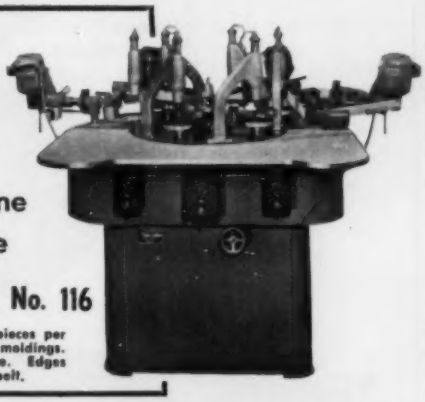

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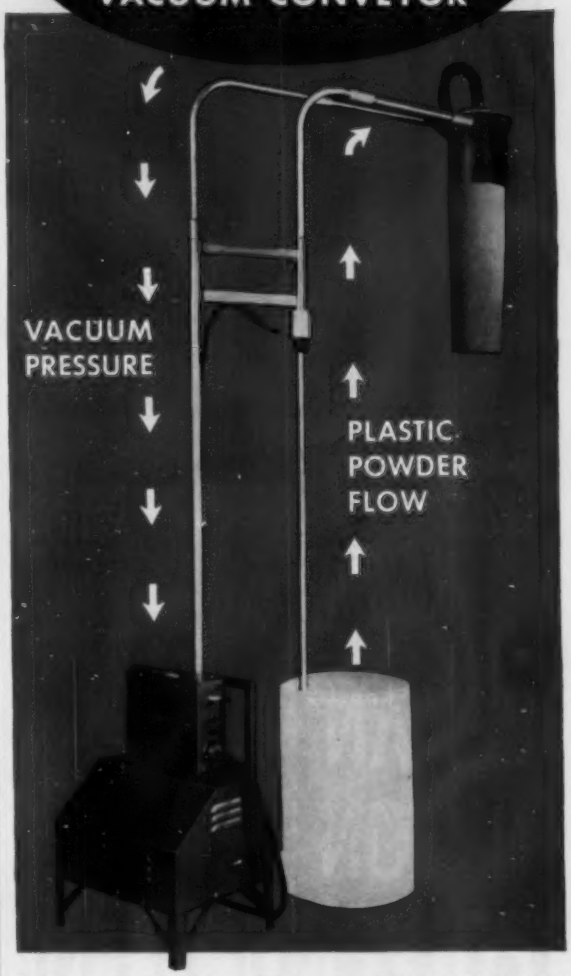

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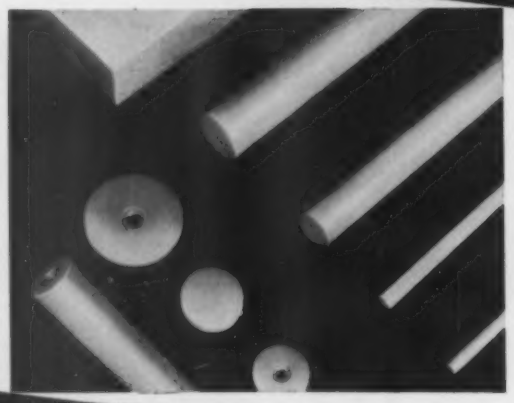

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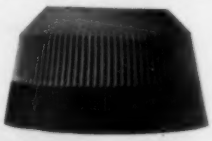

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THE PLASTISCOPE

(From page 232)

tory will supply chlorine, one of the primary raw materials. The plant will be the first to produce polyvinyl chloride in Colombia. Production is expected to begin in early 1962.

Chicago Molded Products Corp. has announced that its Mexican affiliate, **Campco de Mexico, S. A.,** has acquired the assets of the **Plastics Fabricating Div. of Celanese Mexicana, S. A.,** Mexico City. Campco de Mexico will continue to manufacture the Celanese lines of Claracel polyethylene, acetate, butyrate and styrene sheet and film; Duraducto plastic pipe and injection molded pipe fittings; and Marcolita fibrous glass reinforced polyester panels, as well as the full line of Chicago Molded Products' Campco brand sheet and film.

Belding Heminway Co. Inc., New York, N. Y. producer of fabrics, has entered the glass fiber field with the acquisition of **Carl Joseph Co. Inc.,** and **Fiber Glass Finishing Corp.,** both of Kulpmont, Pa., and has formed a new organization, **Belding Corticelli Fiber Glass Fabrics Inc.,** which will weave glass fiber into decorative and industrial fabrics.

Nosco Plastics Inc., Erie, Pa., has purchased **aaRBee Plastic Co.,** Inglewood, Calif., custom molder and extruder, which will henceforth be known as **aaRBee Plastic Co., Western Div., Nosco Plastics Inc.**

Reichhold Chemicals Inc. has purchased a large tract of land in 's-Hertogenbosch, The Netherlands, as a site for a chemical plant. The plant will be operated by newly formed **Reichhold Holland,** which will also handle all Reichhold imports from the U. S. to the European Common Market. The company has also completed plans for the manufacture of vinyl acetate monomer under a license agreement with **Wacker Chemie G.m.b.H.,** Munich, Germany. The production of the chemical will be handled by a new plant in Houston, Texas, which **(To page 237)**

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(Raw Materials)

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Polystyrene: Crystal Clear, Colors, High Impact in Natural and Colors.
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Our large inventory of all materials assures *speedy* delivery.

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- Painstaking care is always taken to formulate orders to your *exact* specifications.
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- We will work with your material or ours.

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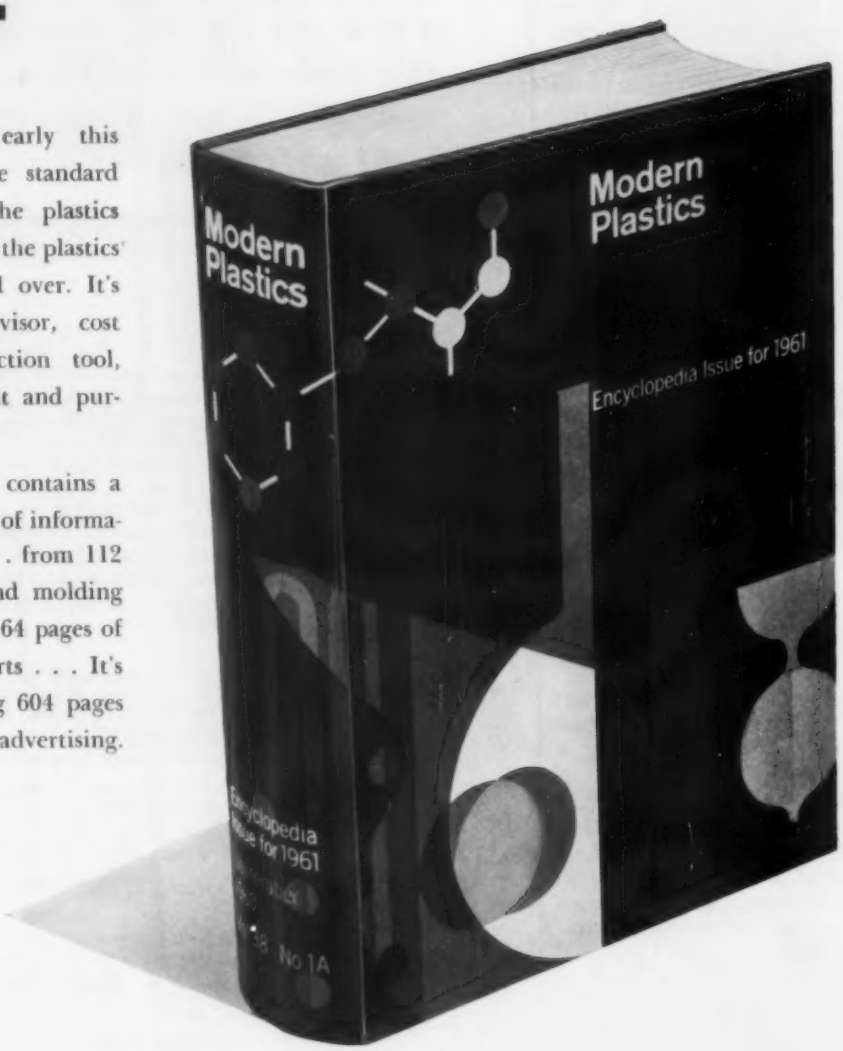
The 1961 Issue contains a total of 1374 pages of information on plastics . . . from 112 pages on resins and molding compounds . . . to 64 pages of technical data charts . . . It's all there including 604 pages of informative advertising. Use it often.



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THE PLASTISCOPE

(From page 235)

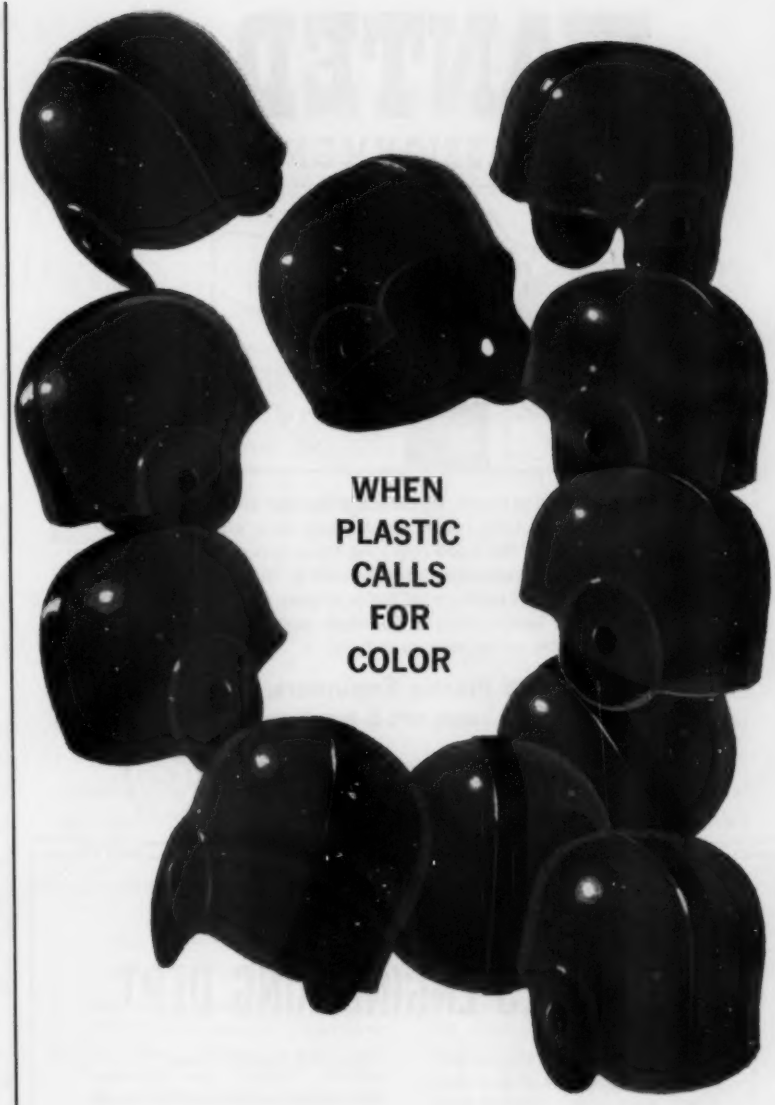
will have an initial capacity of 50 million lb. Expansion to 100 million lb. annually is planned.

Lucidol Div., Wallace & Tiernan Inc., is planning a new $750,000 research laboratory to be built on its property in Tonawanda, N. Y. The U-shaped construction, with over 20,000 sq. ft. of space, will include 10 individual laboratories. Full operations are expected by August 1961.

Carl N. Beetle Plastics Corp., Fall River, Mass., a subsidiary of **Crompton & Knowles Corp.,** is increasing manufacturing space of its 45,300-sq.-ft. plant by approximately two-thirds. Production in the new work area is scheduled for January 1, and employment will be increased. The company manufactures fibrous glass reinforced plastics for large structures by open molding. **Richard C. Bryan,** vice-president and general manager of Beetle Plastics, also heads up the recently organized plastics division of Crompton & Knowles, which includes the newly acquired **Firmaline Products,** Midland Park, N. J. manufacturers of reinforced plastics in the electronics, electrical, aircraft, marine, and transportation fields.

Almac Plastics Inc., New York, N. Y. supplier of plastic sheets, rods, and tubes, has acquired the business and facilities of **Aristocrat Plastics Co.,** Newark, N. J. The new acquisition will be operated as a division of Almac, and will serve as the New Jersey sales center and warehouse. The company stocks acrylic, vinyl acetate, phenolics, polyethylene, polystyrene, nylon, Kel-F, and high-pressure laminates in all commercial forms.

Northwest Plastics Inc., St. Paul, Minn., has announced construction of a new molding plant and the formation of a subsidiary corporation to operate it. To be called **Plastronics Inc.,** the new facility is now being built at Grundy Center, Iowa, with an investment of $300,000. It is the **(To page 238)**



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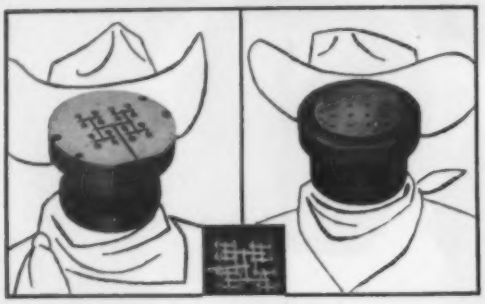

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If you possess a degree in Engineering or one of the sciences and can qualify, we offer a key engineering position in a salary bracket designed to interest you. This is one of the nation's most vital industries, a Midwestern Division of a national manufacturing organization. We offer security, plus unusually generous company benefits, in a Midwestern community which is famous for its beauty and low cost of living. All replies will be strictly confidential.

For Personal Interview, send resume to Box 6696, Modern Plastics.

THE PLASTISCOPE

(From page 237)

third wholly owned subsidiary and factory established by Northwest Plastics in the past three years. Other subsidiaries are at Belle Plaine, Minn., and Gastonia, N. C. Northwest Plastics produces custom and proprietary parts for the electrical, electronics, and appliance industries. It also has a proprietary line of household utensils which it sells under the name of Norplac.

Foster Grant Co. Inc., Leominster, Mass., has established a subsidiary near Rotterdam, The Netherlands, where it will install facilities for compounding and coloring Foster Grant polystyrene, nylon-6, and copolymer resins. Plans for the site, at a later date include a plant for resin polymerization and possible raw materials manufacture.

Taylor Fibre Co., Norristown, Pa. manufacturer of laminated plastics and vulcanized fibre, has acquired, through an exchange of stock, **Dytronics Inc.,** Rochester, Mich. manufacturer of die-stamped circuits for electrical and electronic applications.

Sinko Mfg. & Tool Co., Chicago, Ill. producer of plastic molded products, has broken ground for a 60,000-sq.-ft. addition to its present plant, which will double its size. The new addition will be used for inventory control, storage facilities and future expansion.

Interchemical Corp., Hawthorne, N. J., has acquired the assets of **Vansul Corp. & Vansul Colors,** Englewood, N. J., which is now part of Interchemical's Color & Chemicals Div. The Vansul Color Dept. will continue operations with its present staff.

The Vansul acquisition rounds out the Interchemical line of dyes and pigment dispersions now being produced for the textile, coatings, and plastics industries.

Vinyl Plastics Inc., Sheboygan, Wis. manufacturer of vinyl floor and wall tile, has begun a $250,000 machinery and equipment expansion which is **(To page 241)**

How reinforced plastics molders and high pressure laminators save time, work, material, money with Phenopregs*

1. Phenopreg prepregs simplify molding operations. Only one material—containing both resin and reinforcement—is used. This eliminates the need for weighing, mixing and hand-applying the compounds. Also the need for resin-reinforcement ratio control.

2. Phenopregs reduce hand labor. Elimination of hand dispersion of resin is one means. Use of custom-slit, sheeted and die-cut Phenopregs is another. And, where simple shapes are to be molded, roll material can frequently be fed right into the dies, for still a third saving of labor.

3. Phenopregs make mass production possible. By eliminating the lengthy process of hand impregnation, and, in the case of hand layups, by eliminating slow production cycles due to long periods for curing, Phenopregs speed up output, improve delivery schedules.

4. Phenopregs mean cleaner molding operations. They eliminate the need for cleaning up after wet molding, saving time, labor.

5. Phenopregs reduce waste. This is because there is no spillage and no mold overflow.

6. Phenopregs cut storage and handling costs. Because only one material has to be stored and handled, Phenopregs greatly reduce costs for these items.

7. Phenopregs produce better products. Phenopregs are superior because they enable the molder to (a) keep a uniform resin-reinforcement ratio throughout his laminate; (b) exercise strict control over the resin content; (c) control the cure because of the even dispersion of curing agents; (d) avoid defect-producing trapped air pockets or tiny air bubbles; and (e) eliminate the harmful effects of moisture . . . since the Phenopregs come predried.

8. Phenopregs build business. Phenopregs open new marketing opportunities by creating improved products—products more desirable because their physical, chemical, mechanical and electrical properties are always consistent.

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Decorative Laminates Fabricon offers you the broadest line of clear and tinted overlay papers, contemporary and classical patterns, wood grains, solid colors, core stock sheets and balancing papers ever manufactured by any single source.

Impregnated Glass Cloth Applications Fabricon offers you phenolic, epoxy, silicone and polyester impreganted grades suitable not only for present applications, but for great new potential uses.

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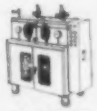

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450° F. Max.
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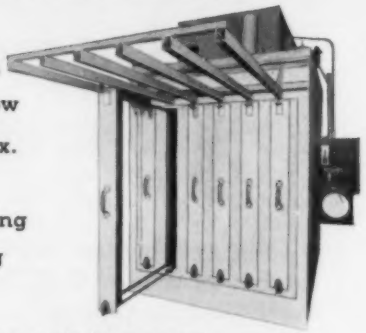

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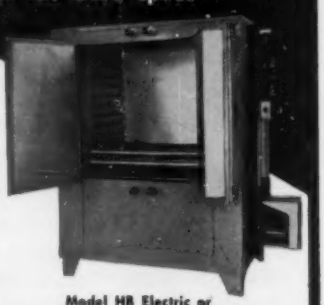

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THE PLASTISCOPE

(From page 238)

expected to increase the plant capacity by $2 million annually. Completion of the installation is scheduled for June 1961.

Meetings

Plastics groups

Nov. 7: Society of Plastics Engineers Inc. (S.P.E.) Ontario Section, "Automation in injection and compression molding," King Edward Sheraton Hotel, Toronto, Canada.

Nov. 18: S.P.E. Newark Section, "Blow molding comes of age," Essex House, Newark, N. J.

Nov. 30-Dec. 2: British Plastics Federation, 2nd International Reinforced Plastics Conference, Cafe Royal, London, England.

Feb. 7-9, 1961: The Society of the Plastics Industry Inc. (S.P.I.) 16th Reinforced Plastics Div. Conference, Edgewater Beach Hotel, Chicago, Ill.

June 5-9: S.P.I. 9th National Plastics Exposition and National Plastics Conference, Coliseum and Commodore Hotel, New York, N. Y.

June 9-17: European Congress of Chemical Engineering and ACHEMA Congress and Exhibition, Frankfurt am Main, Germany. Simultaneously, and in the same city, 15th Meeting of European Federation of Corrosion.

June 21-July 1: Interplas 61, 6th International Plastics Exhibition and Convention, Olympia, London, England.

Other groups

Nov. 13-15: 2nd Annual Toy Production Show, Trade Show Building, New York, N. Y.

Nov. 22: Manufacturing Chemists' Assn., 10th Semi-Annual Meeting and Midyear Conference, Statler Hilton Hotel, New York, N. Y.

Dec. 12-15: 1st Industrial Building Exposition & Congress, also concurrent Conference Sessions, including "New developments in application of plastics to construction," Coliseum, New York, N. Y.—**End**

COMPANIES...PEOPLE

Appointments, promotions, and relocations in the plastics industry.

B. F. Goodrich Chemical Co., Cleveland, Ohio: **George W. Flanagan** appointed mgr. of defense sales and service, will also continue to serve as the company's Washington rep. He succeeds **Marcy W. Osborne**, named gen. mgr. of **B. F. Goodrich-C. S. R. Chemicals Pty. Ltd.**, a firm recently established in Australia by BFG Chemical and C.S.R. Chemicals Pty. Ltd. of Sydney.

B. F. Goodrich Co. Research Center, Brecksville, Ohio: **Dr. Max E. Roha** named mgr. of plastics research. He joined BFG in 1949.

B. F. Goodrich Industrial Products Co., Akron, Ohio: **Anthony Latona**, sr. product engineer in the adhesives div., appointed mgr. of the div.'s latex and plastisol compounding and development laboratory.

Allied Chemical Corp.—Plastics & Coal Chemicals Div.: J. G. (Pete) Bronson named asst. to **John C. Esher**, dir. of sales. **Lorne C. Stocker** appointed chemical product mgr.; **Bruce W. Carney**, asst. chemical sales mgr.; and **Edward M. Lemon**, regional chemical mgr. (West Coast).

Monsanto Chemical Co.: Constantine E. Sotiriou joined the engineering dept.; **Dr. Stanley F. Osman**, the research dept.; and **Richard R. Saxton**, the production tech. service dept. at the company's Plastics Div. plant in Springfield, Mass. **Ernest S. Robson** dir. of sales, Organic Chemicals Div. at New York, transferred to the company's St. Louis, Mo. headquarters in the same capacity.

Union Carbide Plastics Co.: John D. Benedito named v-p—special projects; **Richard M. Joslin**, v-p—sales. Mr. Benedito became gen. sales mgr. in 1956. Later that same year he was appointed a v-p of the company. Mr. Joslin joined the firm in 1935. He has been engaged in chemicals sales in various capacities since that time. Most recently he has been dir. of new chemicals marketing.

Union Carbide Plastics Co. established a new sales office and warehouse facilities in Minneapolis, Minn. for handling and sale of Bakelite brand plastic molding and extrusion materials. **Robert K. Louis**, tech. sales rep., transferred from Milwaukee, Wis. to the new office. **W. J. Prevost** named mgr. of the Detroit, Mich. dist. office, and **Dr. R. W. Quarles** named mgr. of patents and licenses in the New York, N. Y. general office.

Norton Laboratories, Lockport, N. Y.: **Ernest R. Summers**, formerly mgr. of product engineering, appointed plant mgr. He was previously associated with General Electric Co. for 36 years; most recently as a product engineer in the Decatur, Ill. plastic div. **Wilhelm R. Schmidt** named plant engineer, and **George Dietz Jr.**, mgr. of product engineering. Norton Laboratories is a subsidiary of **Auburn Plastics Inc.**, Auburn, N. Y. custom molder.

American Cyanamid Co.'s Plastic & Resins Div. moved its exec. offices to a new administration building at the division's plant on S. Cherry St., Wallingford, Conn.

Enjay Chemical Co., Div. of Humble Oil & Refining Co.: G. W. Miller named asst. mgr. of the company's new Plastics & Resins Div. Enjay recently combined the product management functions for Buton and petroleum resins and Escon polypropylene into one div. Mr. Miller had been responsible for product management functions for Buton resins since Jan. **C. E. Farnsworth**, who had been serving as product mgr., plastics, will head the combined Plastics & Resins Div.

Poly-Fibre Assocs. Inc., Avenel, N. J., now has facilities for custom filament winding of fibrous glass reinforced polyester resin for corrosion resistant industrial products in addition to its usual custom fabricated tanks, troughs, etc.

The Polymer Corp., Reading, Pa., established a New England office at 967 Farmington Ave., West Hartford, Conn., headed by **William H. Wadhams**, dist. sales mgr., who will represent the **Whirlclad Div.** in its program of engineering new industrial fluidized-bed coating installations, manufacture and sale of Corvel coating materials, and development of custom coating facilities.

Rohm & Haas Co., Knoxville, Tenn. plant: **Walter B. Hayes**, formerly production mgr., appointed mgr., replacing **Kenneth R. Kaiser**, who died recently. **R. K. Collins Jr.** named chief engineer. **Enno T. Sauer** will be transferred from production control group, Philadelphia, Pa. office to the Knoxville plant as asst. plant mgr. within the next several months.

National Vintex Corp., Canadian vinyl coating, embossing, and printing firm, moved from Montreal to its own newly built plant at 225 Montcalm Blvd., Candiac, P. Q.

Eli Sandman Co., Worcester, Mass.: **Mrs. Dora L. Sandman** assumed gen. management of the company's operations, succeeding her late husband as pres. **Harold N. Cotton** appointed sales mgr. in addition to his duties as asst. to the pres. **Mr. Jean L. Lewis**, tech. dir., named plant supt. The company is a producer of preimpregnated materials for the reinforced plastics industry.

Industrial Plastics & Equipment Co., Orange, N. J.: **John B. Anderson** named asst. plant mgr. **Pat S. Petrillo** appointed to sales force. The company is a fabricator and distributor of Kel-F, Teflon, Teflon-100X, nylon, phenolic, and other fluorocarbon sheets, rods, tubes, and molded shapes.

Ludlow Corp., Needham Heights, Mass.: **Dr. A. W. Fisher Jr.** appointed exec. v-p, and **Dr. H. H. Reynolds** v-p, R & D, for both **Ludlow Papers** and **Ludlow Plastics**, divisions of the corporation.

Plastiline Inc., mfr. of plastic pipe fitting, thread protectors, and custom molder, moved to a newly constructed plant in Pompano Beach, Fla. The present White Plains, N. Y. sales office and warehouse will be retained to serve the Northeastern market area.

Nypel Corp., West Conshohocken, Pa. mfr. and supplier of nylon molding compounds, named **James Redman** western region rep., with headquarters in Los Angeles, Calif., and **Allan McConnell**, Midwestern rep.

Space Structures Inc., Chanhassen, Minn., plastics research and fabricating firm, appointed **LeRoy Wellens**, **Robert L. McConnon**, and **Peter Redpath** to its sales engineering staff.

Edward B. Twombly Jr. named v-p in charge of sales for **M. W. Parsons-Plymouth Inc.**, New York, N.Y. mfr. of metallic stearates and fatty acid esters. **Philip D. Reed Jr.** is v-p in charge of operations.

Ross A. Corio, previously with Union Carbide Chemicals Co., appointed v-p in charge of marketing and sales for **W. R. Grace & Co.'s Hatco Chemical Div.**, mfr. of chemicals for the plastics, rubber, and aircraft industries.

Robert E. Bischak, tech. supv. at the Kenton, Ohio plant of **Durez Plastics Div., Hooker Chemical Corp.**, returned to the N. Tonawanda, N. Y. plant to train as future tech. supv. at the Durez plant to be built at South Shore, Ky. Start-up is scheduled for ap- **(To page 244)**

with the

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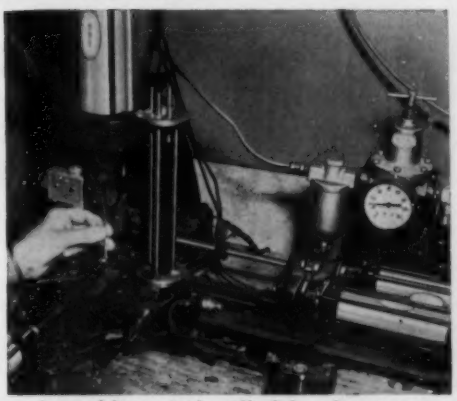
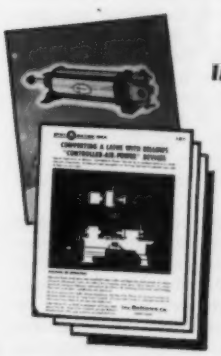
With parts normally available in every tool room, plus one or more Bellows Air Motors, and a little creative ingenuity, you can "spot modernize" scores of operations whose high cost whittles away at profits. The few illustrated here are typical of hundreds we can show you. The chances are good that no matter what you make, nor how you make it, this versatile air cylinder, with its *built-in* electrically controlled valve, can lend a mighty important helping hand to your cost reduction program.



Assembling tin-handled brushes into molded plastic caps is speeded and simplified with this shop-built machine powered by Bellows Air Motors.



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For your free copies, write: Dept. MP-1060, Bellows-Valvair, Akron 9, Ohio.

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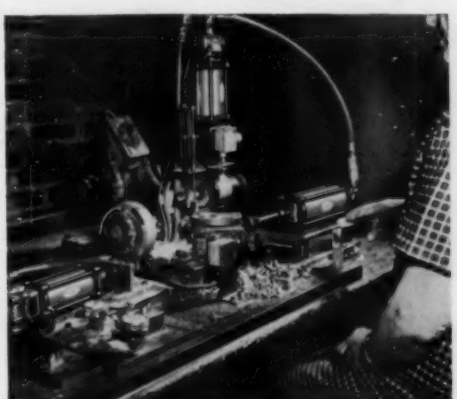

Built around three interlocked Bellows Air Motors, this special machine for milling and drilling a linen base Bakelite part tripled production.

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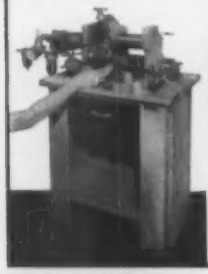

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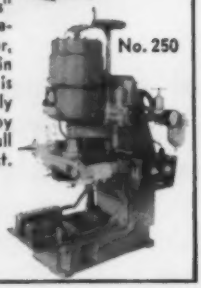

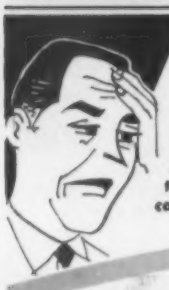

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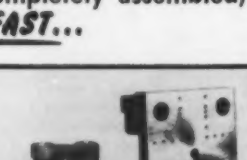

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COMPANIES...PEOPLE

(From page 242)

proximately the end of 1961. **Diamond Pipiles**, process engineer at N. Tonawanda, succeeds Mr. Bischak at Kenton.

Richard H. McCarthy Jr. appointed v-p in charge of sales for the **Bradley-Sun Div., American Can Co.** He will be responsible for sales of collapsible plastic and metal tubes, plastic squeeze bottles, and other products made by the div.

Herman Reffe appointed to head up all sales for **Cordo Molding Products Inc.**, New York, N. Y. exclusive distributor of Cordopreg-Mobaloy prepregs made by **Cordo Chemical Corp.** of Norwalk, Conn.

John L. Cook appointed Midwest mgr. in the Naperville, Ill. office of **Hull Corp.**, Hatboro, Pa. mfr. of Hull-Standard molding presses, high vacuum process equipment, and liquid resin metering, mixing, and dispensing systems.

Donald N. Kidd appointed mgr., sales engineering, for **American Insulator Corp.**, New Freedom, Pa. custom molding firm.

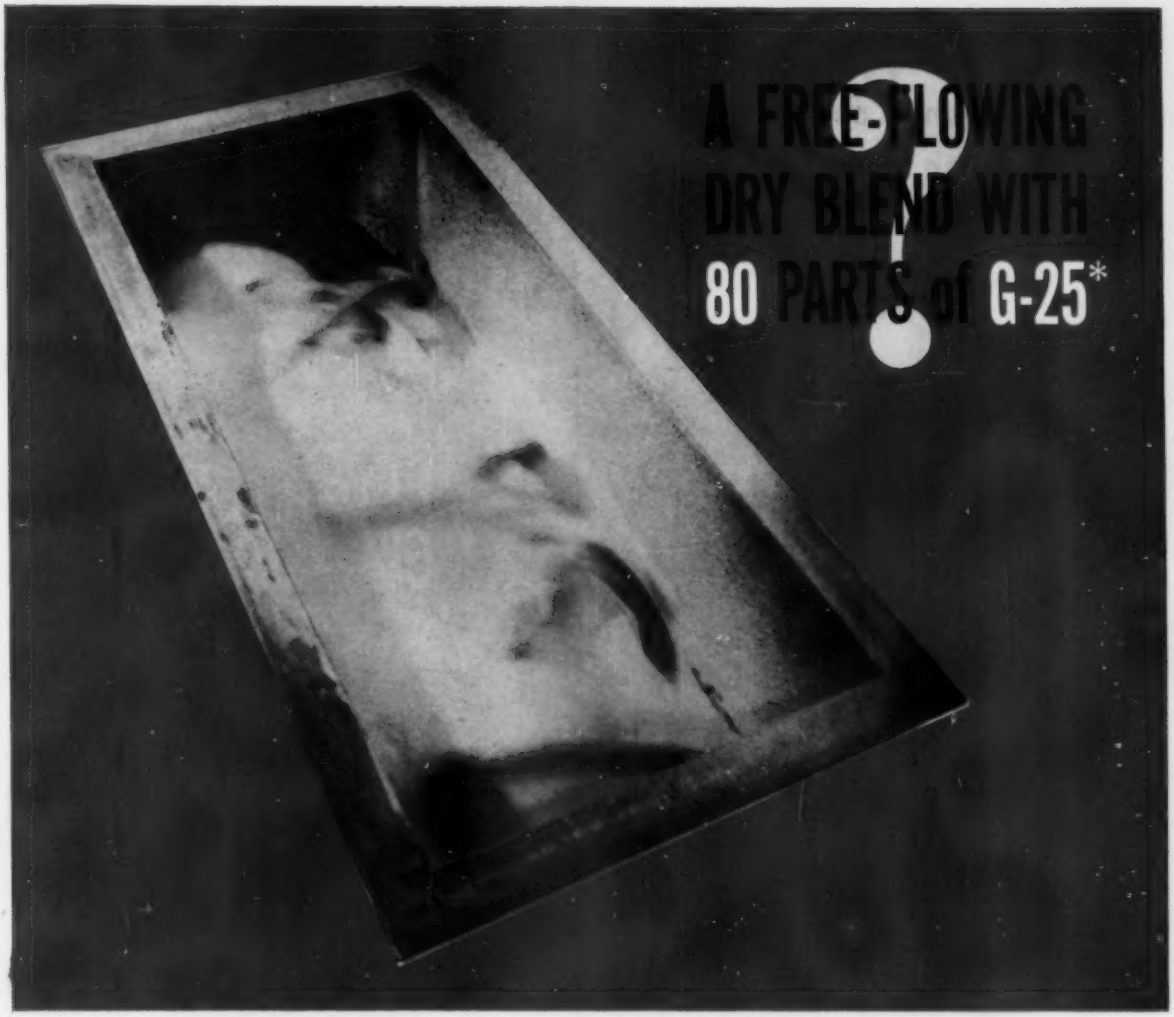
Alvin E. Jerome appointed sales rep., for the Polyco-Monomer Dept., **Borden Chemical Co.**, responsible for sales of synthetic resins in the New England states. He will headquarter in Leominster, Mass.

Roland Barrett, gen. mgr. of **Brilhart Plastics Corp.**, Mineola, N. Y., heads the company's Research Div. for development of thermoset and thermoplastic moldings for the electronics and missiles field.

Bernard G. Achhammer, asst. chief of the Plastics Section of the National Bureau of Standards, has received a **U. S. Dept. of Commerce** silver medal for meritorious service. He was cited for "his outstanding contributions to the science of plastics and polymers, in particular chemical structure and stability relationships, and for meritorious authorship."

Mr. Achhammer directs degradation studies on polymers, such as polyamides, polystyrene, and polyvinyl chloride; studies the use of physical chemical techniques for analysis of polymer breakdown; and participates in establishing specifications and test methods for plastics.

Herman Ratner, formerly sales mgr. of **Regency Plastics Inc.**, Woodside, N. Y. and **Great Bay Chemicals & Plastics Inc.**, E. Brunswick, N. J., appointed v-p of both companies, wholly owned subsidiaries of **Cary Chemicals Inc.** Mr. Ratner's new duties will be concerned **(To page 247)**



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This new homopolymer series has demonstrated amazing ability to absorb even the most viscous plasticizers at extreme ratios and still give you free-flowing dry blends with unusual freedom from gels.

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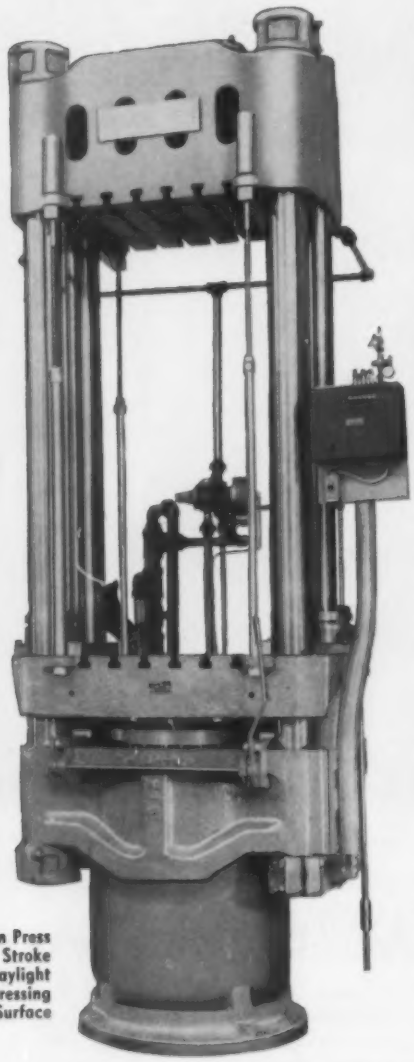
Pound Costs Down
With Every Stroke



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36" Stroke
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COMPANIES...PEOPLE

(From page 244)

with administration and planning, but he will still direct national sales of Regency vinyl and polyethylene fabrics, as well as sales of calendered vinyl made by Great Bay.

Fred M. Stefan elected pres. and a dir. of **Milprint Inc.**, flexible packaging subsidiary of **Philip Morris Inc.**

Jack R. Siegelbaum appointed product sales mgr., plasticizer div., for **Reichhold Chemicals Inc.** He will also act as liaison between RCI management and its newly-acquired **Deecy Products Co.**, a manufacturer of plasticizers.

Raul F. Colbert named export sales rep. for **U. S. Industrial Chemicals Co.'s** Petrothene polyethylene resins.

Richard Ragnow appointed Midwest tech. rep. for **Weber Plastics Inc.**, Stevens Point, Wis. custom molder of expandable polystyrene.

George M. Schau, formerly with Erie Resistor Corp., appointed gen. sales mgr. for **Perry Plastics, Inc.**, Erie, Pa. custom molder. He is v-p of the **Society of Plastics Engineers**, Northwest Pa. Chapter.

N. V. Wood promoted to mgr., engineering development by **Mobay Chemical Co.**

John F. Gitre named mgr. of a new branch and warehouse established by **Cadillac Plastic & Chemical Co.** at 3015 S. Division, Grand Rapids, Mich. This is the company's 17th warehouse facility. The main offices and mfg. plant are in Detroit, Mich.

George J. Scheuer appointed to newly created position of mgr., plastics div., for **Chemo Products Inc.**, West Warwick, R. I. mfr. of coated glass yarns and a wide variety of products made of Teflon.

William R. Whitaker appointed sales mgr. of the plastics products div. at **Advance Solvents & Chemical**, New Brunswick, N. J.

James R. Pendry appointed gen. sales mgr. of **Rubber Corp. of America**, Hicksville, N. Y. mfr. of plastic and chemical products.

Fred T. Kottenstette, formerly chemical salesman for **Texas Butadiene & Chemical Corp.** in its Houston, Texas office, promoted to group leader, sales development, in the New York, N. Y. exec. offices.

Dan F. Sweet appointed gen. sales mgr. for the industrial plastic products plant of **St. Regis Paper Co.'s Panelyte Div.**, Trenton, N. J. The plant makes plas- **(To page 248)**

"There's no question, improved plastic designs and new colors have increased Style-Setter Sales."

M. P. CONRAD, PRESIDENT
LOUISVILLE CHAIR CO.

Kentucky Color is constantly developing new and better colors for plastics . . . Take advantage of this service by writing for full information.

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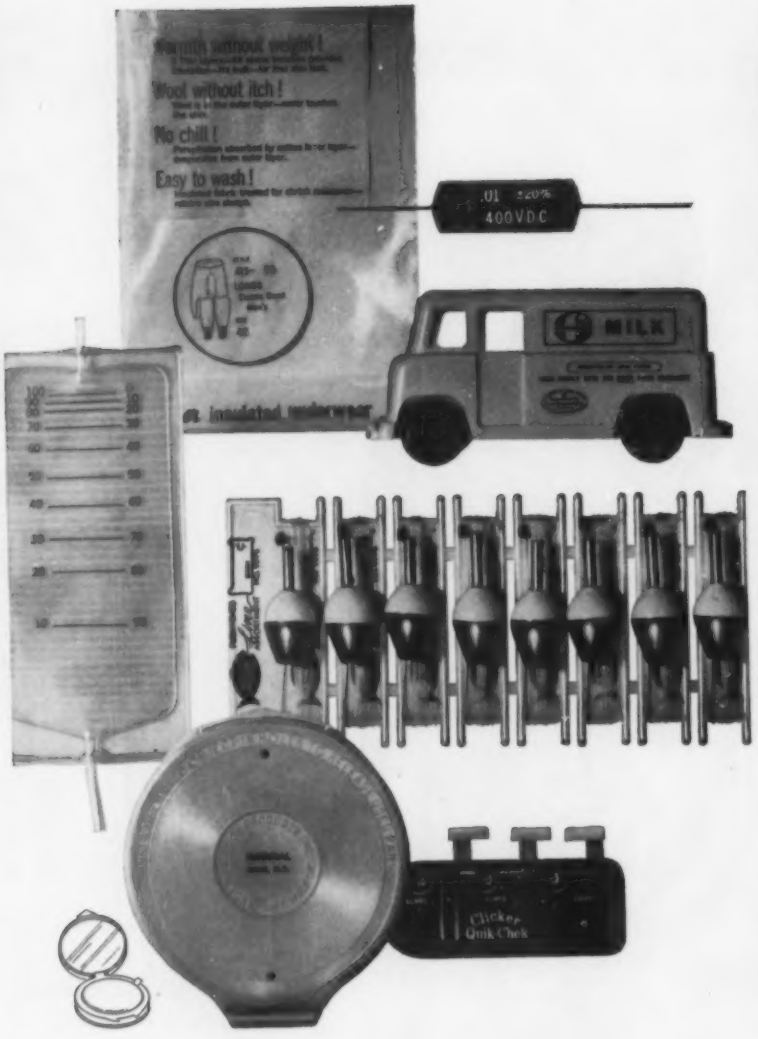
Division of THE HARSHAW CHEMICAL COMPANY, LOUISVILLE, KENTUCKY



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—*it stops the eye, tells the story, helps the sale.* This is marking *everybody* can read—made by Markem machines and printing elements. And perhaps most important, the Markem *specialty inks* used have just the right combination of opacity, color, adhesion and drying speed each type of plastic requires.

This is the "Markem method" that can be working for you—the *right* machine, type and ink to do *your* particular marking job quickly, clearly and at low cost, in your own plant. It *stays* clear and attractive because it stays *on* your product and can't fall off or easily smudge. Call your Markem representative for complete facts, or write Markem Machine Co., Keene 20, N. H.

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COMPANIES . . . PEOPLE

(From page 247)

tic laminates, compression moldings, bearings, and other products. Mr. Sweet has been with Panelyte for 20 years. He succeeds **John Zeier**, who has resigned.

Bernard D. Ashbaugh named mgr., plastics equipment for **Farrel-Birmingham Co. Inc., Watson-Stillman Press Div.**, Rochester, N. Y.

Lawrence F. Shannon appointed gen. sales mgr. of **Holyoke Plastics Co. Inc.**, custom molder of components for the electrical, automotive, and electronic industries.

Herbert O. Corbett, formerly group supv. R & D, appointed chief extrusion technologist for **The Kordite Co.**, Macedon, N. Y.

New reps.

Kaiser-Reismann Corp., 325 Spring St., New York, N. Y., named national distributor for **Reeves Brothers Inc.** Reevon polypropylene bristles for brushes. . . . **Fiber Glass Reinforcements Inc.**, 667 S. Anderson St., Los Angeles, Calif., appointed distributor in Calif. and Ariz. for **Johns-Manville** fiber glass roving, chopped strands, and Garan mat. . . . **Dixon & Co.**, Denver, Colo., appointed distributor in the Rocky Mountain area for **AviSun Corp.'s** Olefane polypropylene packaging film. . . .

Corrosioneering Inc., 1909 Wensley Drive, Charlotte, N. C., named rep. for **The Ceilcote Co.'s** line of corrosion-proofing materials for industry. . . . **Navajo Supply Co.**, 2400 4th St., Lubbock, Texas, appointed distributor for **The General Tire & Rubber Co.'s** Bolta lines of vinyl wall, floor, and hard-surface furniture covering materials. . . . **John R. Davis & Co.**, 3038 Surrey Lane, Chamblee, Ga., appointed southeastern rep. for **Modern Plastic Machinery Corp.**, Clifton, N. J. . . .

Kinne Sales Engineering Co., 10 Brookfield Rd., Upper Montclair, N. J., appointed exclusive rep. for **Kabar Mfg. Corp.**, Roosevelt, N. Y., mfr. of heat sealing equipment. . . . **Western Fibrous Glass Products Co.**, 2915 First Ave. S., Seattle, Wash., named sales rep. in Wash., Ore., and Idaho for **G. T. Schjeldahl Co.'s** plastic laminates, adhesives and tapes, and electronic products. . . .

General Electric appointed the following distributors for its Textolite line of industrial laminates: **A&A Supply Co.**, Dallas, Texas—Texas, Okla., La., Miss., Ark., Mo., Ariz., and New Mexico; **Eiler Equipment Co.**, Minneapolis, Minn. — Minn., Iowa, Neb., N. and S. Dakota, and parts of Wis.; **Read Plastics Inc.**, Washington, D. C.—Md., Va., and D.C.; **The Harva Co.**, Schoharie, N.Y.—central New York state.—End

finer finish faster
longer mold life

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Production economy, longer mold life, and a superior product are assured by finishing with Hyprez Diamond Compounds. Pure diamond powders, exactly graded and permanently dispersed in a scientific vehicle—under strict laboratory control—these are your guarantee of finer finishes, faster, with Hyprez.

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Plastisols possess the outstanding physical and chemical properties associated with vinyl resins and are *individually formulated* to specific requirements of a wide variety of end uses.

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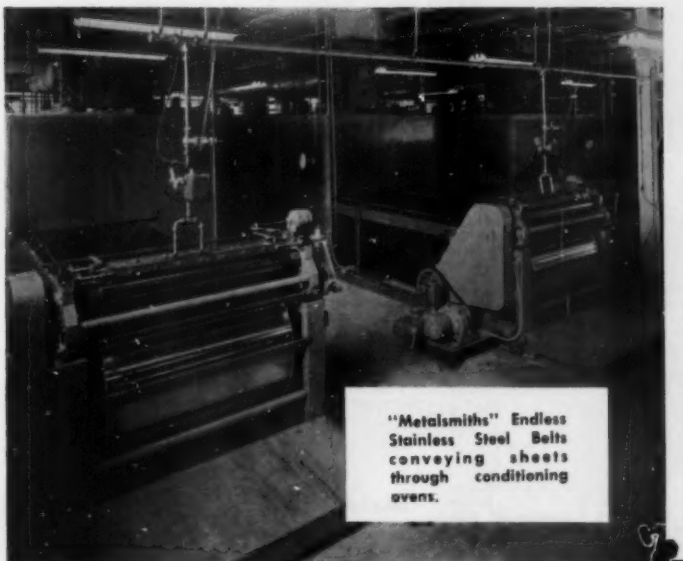

"Metalsmiths" Endless Stainless Steel Belts conveying sheets through conditioning ovens.

WIDTHS UP TO 85"

"Metalsmiths" (18-8) stainless steel belts are available in widths up to 58" in one piece without center seam; extra-wide sizes to 85" have longitudinal weld at center, finished to smooth, seamless working surface. High gloss or matte finishes available.

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3. CUTS COST

Increased production per shift reduces your costs—uniformly high quality reduces rejects and "seconds".

Consult our engineers on the possibilities for your products, without obligation.

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Machinery and Equipment For Sale

FOR SALE—BANBURY MIDGET mixer; 1-Farrell Birmingham 8" x 16" Chrome Plated 2-Roll Mill; 1-Baker-Perkins 10 gal. 304 SS Sigma Blade Mixer; 1-Baker-Perkins 100 gal. Sigma Blade Mixer; 1-Baker-Perkins size 16 TRM 150 gal. double arm Vacuum Mixer; 1-No. 1 Ball & Jewell Rotary Cutter; 2—Mikro Pulverizers, SS Bantam, #1 SH. 6—Stokes Model DD2, DS3, D3, and B2 Rotary Preform Presses, partial listing; we purchase your surplus. Brill Equipment Co., 35-65 Jabez St., Newark 5, N. J. Tel: MArket 3-7420.

FOR SALE—ONE YEAR OLD, Used one month. One 12" x 22" Pressure Vac Mark 11 pressure forming machine. One Automatic Indexing. Claremould Plastics Co., 200 Wright St., Newark, N. J.

INJECTION MOULDING MACHINERY bargains. Plastics manufacturer has surplus used injection moulding machines available at low prices. Included are 6 oz. Lester, 8, 10 and 16 oz. Reed. All units in good condition. Write M. Wintrob & Sons, Canada Limited, 260 Spadina Ave., Toronto 2b, Canada.

MOST MODERN PACKAGING AND PROCESSING MACHINERY, available at great savings. Baker Perkins, W. & P. and Day Double Arm Steam Jacketed Heavy Duty Mixers—25, 50, 75, 100, 150 and 200 gal. capacites. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers, Jacketed and Unjacketed. Also wood and enamel. Day Imperial 75 gal. Double Arm Mixer, Sigma, Dispersion Blades. Mikro Pulverizers. Models Bantam, 1SH, 2TH, 3TH and 4TH. Fitzpatrick Models D, K-7 and K-8 Stainless Steel Comminuters. Stokes Models R, RB-2 and Eureka Tablet Machines. Colton 2RP, 3RP, 3B, 5½ T Tablet Machines. Stainless Steel Jacketed Mixing Kettles 100 and 150 gal. capacities. Robinson Stainless Steel Double Arm Mixer for dry and viscous materials Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Cartoning Machines—Ceco, Pneumatic Scale, Jones. Standard Knapp, A-B-C, Ferguson Carton Sealers. Filling Machines—all types and sizes. Union Standard Equipment Company, 318 Lafayette Street, New York 12, N. Y. Phone: CAnal 6-5334.

FOR SALE—SUPERHORNET MINIJECTOR—all hydraulic—¾ oz. Also 18" Royal bench mounted drill press—both new 1958—used only for development lab—110 volt, 1 HP motors—outright sale or continuation of straight rental contract. Write Box 6685, Modern Plastics.

FOR SALE: SPROUT-WALDRON 335 cu. ft. Unused horiz. ribbon blender. Sturtevant #9 150 cu. ft. unused rotary blender. Baker-Perkins #15-UUMM 100 gal. Dispersion blade mixer, jkt., 100 HP, cored blades, comp. cover. Stainless Reactors or Resin Kettles: 3500, 1900, 750, 500 gal., jktd. and agit. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE—PLASTIC SHEETING MACHINE. Will sheet material 54" wide, from 0 to 30" long. Reply Box 6689, Modern Plastics.

FOR SALE—6" EXTRUDERS & 6" STRAINERS complete with motor & heads for pelletizing. Rego, Inc., 830 Monroe St., Hoboken, N. J. OL 6-2020.

FOR SALE: MPM 3½" WIRE covering Extruder. New ¾" Plastic Extruder. Other sizes up to 6". Seco 6" x 12" and 8" x 16", 2-Roll Mills and calenders and other sizes up to 60". 350 ton Hydr. Press, 5 opening, 42" x 42" platens. W.S. 240 ton, ten 24" x 56" platens. W. & W. 200 ton 24" x 42". Stokes Standard 150 ton Semi-automatic. French Oil 120 ton self-contained, 120 ton Upstroke, 29" x 21", 10" stroke. 60 ton Farquhar 50" x 50", 30" stroke. Stokes 50 ton Semi-automatic 22" x 12". 50 ton Birdsboro 24" x 20". Stokes 15 ton automatic. Hydraulic pumps and accumulators. 60" Spreader Heads with XP motors. Despatch electric heated ovens and other types. New ¾ oz. Bench Model Injection Molding Machines. Van Dorn 1 and 2 oz. Other sizes up to 100 ozs. Baker-Perkins and Day Jacketed Mixers. Taylor-Stiles Pelletizer, 7½ HP. Plastic Grinders. Stokes RD3 Rotary Preform Tablet Machine. Colton 4½T single punch. Send for listings. We buy your surplus Machinery. Stein Equipment Company, 107-8th Street, Brooklyn 15, New York.

FOR SALE — INJECTION MOLDING MACHINES 1953 8 oz Reed Prentice with straight bore nylon cylinder 1950-1952 12 oz Reed Prentice Model 10D12 1955 48 oz HPM with Vickers Pumps—Low pressure mold protection. May be seen in operation at American Molded Products Co., 2727 W. Chicago Avenue, Chicago 22, Illinois.

FOR SALE—2—DUNNING & BOSCHERT 300 ton molding presses; 1—Stokes standard 50 ton self-contained transfer molding press model 258-A; 2—Hartig 2" electrically heated extruders with complete blow molding set up. 1—Cumberland 7" stair step dicer, stainless steel; 2—Ball & Jewell granulators, #1, #1½. Chemical & Process Machinery Corp., 52 9th Street, Brooklyn 15, N. Y., HY 9-7200.

FALL SPECIALS—24 OZ. WATSON STILLMAN Injection Molding Machine. Equipped with Pre-plasticizers. Late Type with all controls. 300 Ton Stokes Transfer Press, full automatic, late type, 2 available. 200 Ton and 150 Ton Transfer Molding Presses, completely self contained, with automatic controls. 12 oz. DeMattia Model B, Injection Molding Machine, complete with wheelco panel board and all controls. 8 oz. Reed Prentice Injection Molding Machine, model 10D8, Double Link. Complete with wheelco controls. Stokes Model R and Colton #5, Colton #4½ T, Single Punch Tablet Presses. Individually motor driven. LaRose Electronic Preheaters, 2 KW and 4 KW in stock. Cumberland #1½ Rotary Scrap Cutter with 10 HP motor. DeMattia & Foremost, 2 & 3 Horse Power Motor Drives. Also in stock: NRM 2½", Royle 3¼", Hartig 3¼", and Adamson 6" Extruders. Also a complete line of Blenders, Mixers, Scrap Cutters, etc., for the Plastic and Rubber Industries. What do you need? What do you want? We Will Finance. Johnson Machinery Company, 90 Elizabeth Avenue, Elizabeth, New Jersey, ELizabeth 5-2300.

FOR SALE—BECK SHEETER available, 44" 5 Roll Stand. In excellent condition, 3 years old. Contact Transparent Bag Co., 746 Washington St., Buffalo, New York.

FOR SALE—1—OLIVER WRAPPING MACHINE #799-T. 6-¾" to 14-¾" long. 5-½" to 10-½" wide. ⅛" to 4-⅛" high. Wrapper rolls from 6" to 23" wide. For operation on 3/60/220 AC, speed 20 to 36 packages per minute. Reply Box 6701, Modern Plastics.

SAVE-BUY FROM LOCATION Equipment just purchased 6 Stokes 150 Ton Molding Presses; self-contained, with 3 HP Hydr. Pump System. Offerings from Stock: 3 Stokes 280 Preform Presses, Stokes #252 Aut. Clos. Press, Colton #5½ T Preform Press. Other Presses by Dunning & Boschert, French Oil Mill, HPM. Baker Perkins Double Arm, Jacketed Mixers to 300 Gal. Stokes Dbl. Chamber Impregnators. Devine Vacuum Shelf Dryers. F-B Unused 2 Roll Mills 14" x 30". Other Mills, Calendars, Extruders. F.M.C. Rental-Purchase Plan. First Machinery Corp., 209-289 Tenth St., Bklyn. 15, N. Y. St. 8-4672—Cable "Effemcy".

Machinery Wanted

WANTED—8 OR 12 OUNCE LESTER, or impco-fellows, etc. injection machines-late models-list particulars. Am principle. Reply Box 6690, Modern Plastics.

EXTRUDERS—WANTED 3½" AND 2½" late models. Electrically heated. NRM preferred. Must be in good condition. Superior Plastics Inc., 426 N. Oakley Blvd., Chicago 12, Illinois. CA 6-4540.

WANTED—300—TON COMPRESSION or Transfer Molding Press. Prefer press with an 18" diameter ram with 18" to 24" travel. Will buy with or without pumping unit. Reply Box 6691, Modern Plastics.

Materials For Sale

FOR SALE—CONVENTIONAL BLACK POLYETHYLENE scrap or reprocessed black pellets in continuing supply. Reply Box 6702, Modern Plastics.

FOR SALE — HONEYCOMBS — ALUMINUM—Big Savings 56 Pcs. 3x42x96 and 28x96—thickness from 1½" to 5½"—⅛ cell—5052 alloy—.001P gauge—first grade goods. Reply—Star Sales Co., 4512½ S. Western Ave., L.A. 62, Calif.

FOR SALE—5,000 LBS. JET BLACK E/C reprocessed pellets. 20,000 lbs. jet black C/A reprocessed pellets. Many other materials at low, low, prices. Reply Box 6709, Modern Plastics.

Materials Wanted

WANTED: PLASTICS OF ALL KINDS—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin and reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

(*Continued on page 252*)

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Type ZSK 120/1500
$4^{3}/_{4}$ inches dia, 200 HP

with these unique design features:

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Interchangeable screw elements for variable screw characteristics in adaptation to the requirements of the product

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(*Continued from page 250*)

PLASTIC SCRAP WANTED—Sell us your mid-year surplus inventories of plastic scrap or surplus molding powders. Acetate, Acrylic, Styrene, Polyethylene, Butyrate, etc. in any form. Write, Wire or Phone Collect: Phillip Shuman & Sons, 571 Howard Street, Buffalo 6, New York. tele: MAdison 3111.

GET THE TOP MONEY FOR PLASTIC SCRAP—Now paying top prices for all thermoplastic scrap. Wanted: polystyrene cellulose, acetate, vinyl, polyethylene, butyrate, acrylic nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE, TODAY! Reply Box 6650, Modern Plastics.

WANTED—POLYETHYLENE STYRENE, POLYPROPHYLENE scrap in any form. Also surplus lots. Top prices paid. Chemsol, Inc., 68 Clifford St., Newark, N. J. MA-3-7515.

WANTED—ACRYLIC, BUTYRATE and acetate scrap. Any quantity of sheet trim, Purgings, reground. For top quotations Call: Claude P. Bamberger, Inc., Ridgefield Park, N. J. HUbbard 9-5330.

Help Wanted

POLYVINYL CHLORIDE RESIN TECHNICAL sales representatives, for sales of top-grade resin to all trades. Plant located in East. Experience in selling users of Polyvinyl Chloride resin required. Advise background and territory covered. Reply to Imperial Chemical & Plastics Corporation, Mill Street, Cranston 5, Rhode Island.

SALES ENGINEER — NATIONALLY KNOWN Midwest custom molding firm has an immediate opening on its sales staff for an aggressive individual between the ages 25-45. Should have a proven record of successful technical sales in compression and injection molding. Chicago territory. Submit resume giving full details on background, experience, education and salary expected. Reply Box 6713, Modern Plastics.

SALESMAN—COVER MASSACHUSETTS, Connecticut and Rhode Island reprocessed and virgin molding compounds. Salary open for man with ability and experience to take over as manager. Reply Box 6686, Modern Plastics.

CHEMIST For research on new polymers and coating materials derived from them. Experience with either vinyl or condensation polymerizations is needed. Knowledge of flame retardant coatings would be helpful. **CHEMIST** For research on new polymerization techniques and for evaluation of the products obtained. Practical experience in the technology of films, coatings or fibers desirable but not essential. **CHEMIST** For research on novel fluorine-bearing polymers. Long established program. Unusual opportunity for experienced man to experiment with materials of the future. **PATENT ATTORNEY** With experience in chemistry and chemical engineering and familiarity with chemical patent applications. This is an excellent opportunity in small but growing department. Opportunities are at Grand Island Research Center or Niagara Falls plant, both in Western New York. Send resume and salary requirement to A. V. Thorpe, Supervisor of Technical Placement, Hooker Chemical Corporation, Niagara Falls, New York.

CHIEF TOOL ENGINEER: Experienced tool engineer for injection molding to have responsibility for full tooling department of 12 men. Salary in five figures with security and many fringe benefits. Established company in northeast with proprietary line of plastic products. Replies held in strictest confidence. Send resume to Box 6716, Modern Plastics.

PLANT SUPERINTENDENT — Small, high-quality, injection molding plant. Must be capable of complete supervision of molding, tooling and finishing operations. Near Los Angeles in beautiful growing community. Top Salary. Only completely capable and experienced man need reply in strict confidence to: Box 6712, Modern Plastics.

REGIONAL REPRESENTATIVE WANTED—High rated mid-western producer of plastic film for converters and users in the packaging and plastics industries, seeks an experienced, aggressive representative for the Great Lakes area Compensation will be based on background and ability. Company pays expenses. Address Box 6687, Modern Plastics.

MOLDING MACHINE SALES AGENTS—For Michigan and Ohio, preferably working out of Detroit and/or Cincinnati areas. Wanted to sell complete line of injection molding machines from 6 oz. to 24 oz. Line established in balance of U.S. and well supported by factory. Only top quality agents need apply. Contact A. Nickerson, V.P., Lombard Governor Corp., Main St., Ashland, Mass.

PLANT MANAGER—Large manufacturing firm in Midwest has opening for manager of subsidiary plant producing polyethylene film, employing up to 75 people. Requires background in polyethylene extruder, dies, casting and slitting machines. Some knowledge of work simplification, time study, job evaluation, production control, material handling techniques essential. Send resume of experience and salary requirements. Replies confidential. Reply Box 6693, Modern Plastics.

PLASTICS ENGINEER OR MECHANICAL ENGINEER INTERESTED IN PLASTICS—Excellent opportunity in southeastern United States with well-established company that has recently branched into plastic injection molding and extrusion. Company has long been established in compression molding. Responsibility includes design, alteration, and repair of injection molds, and design and cost estimates for new plastic products, repair and maintain molding equipment and establish and supervise molding techniques. Experience desired. Replies held in strict confidence. Salary open and all fringe benefits provided. Reply Box 6694, Modern Plastics.

PLASTICS ENGINEERS—Openings in Applications Research Laboratory in North Jersey metropolitan area. Degree in Chemistry, Chemical or Mechanical Engineering required; thermoplastic or thermosetting experience desirable. Position involves laboratory applications work and customer service. Liberal company benefits. Please send complete resume and salary requirements to B. T. McMillan, Laboratory Director, Plastics & Coal Chemicals Division, Allied Chemical Corp., 1 River Road, Edgewater, New Jersey.

PLASTIC DESIGN ENGINEER WANTED—AAA1 company, engaged in the manufacture of injection-molded, blow-molded and vacuum-molded toys and other juvenile products, has excellent opening for a qualified plastic engineer with a good background of product design. Duties will include supervision of model shop, some board work, training in cost estimating, and product engineering. Excellent opportunity for advancement to an executive position in product development. Location N. Y. C., pleasant working conditions, many benefits. Send complete resume to Box 6692, Modern Plastics.

GENERAL FOREMAN, OPERATORS For Extrusion Coating and Laminating Operation. Rare opportunity to handle rapidly growing new Processing Department. Must have extensive experience. Will be working with latest model equipment. Chase Bag Company, 5033 Southwest Avenue, St., Louis 10, Missouri.

PROCESS ENGINEER—With experience in blown film extrusion, as well as Laminating and Coating Equipment. Unusual opportunity for talented individual in rapidly expanding plant. Variety of processes involved, including extensive new machinery installations. Excellent salary and other benefits. Chase Bag Company, 5033 Southwest Avenue, St. Louis 10, Missouri.

SALES MANAGER To head newly created Division of Extrusion Coated and Laminated Products. Outstanding opportunity with America's Oldest Bag Manufacturer. Individual must be experienced in this line and will have wide latitude in establishing and managing national organization. Excellent salary and other benefits. Plastics Division, Chase Bag Company, 355 Lexington Avenue, New York 17, N. Y.

PRODUCT SALES ENGINEER—PLASTIC extruding. Long established East Coast leading designer and manufacturer of rubber and plastics extruders will add a sales engineer to solicit and handle proposals, advise customers on problem solutions and co-ordinate application engineering on wide variety of extruding equipment. Must have engineering degree and substantial experience in plastic extrusion processing with some design experience. Write full particulars to Box 6700, Modern Plastics.

PLANT MANAGER—Extrusion & Blow molding experience, Write or phone giving full details. Riverside Plastics, Inc., 140 Green Avenue, Woodbury, New Jersey, Phone: TIlden 5-7458, (Phila.) PIoneer 3-2962.

WANTED—MANUFACTURERS' REPRESENTATIVE with Custom Mold following to represent new modern plant. All territories. Write fully. Box 6703, Modern Plastics.

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(*Continued on page 254*)

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(*Continued from page 252*)

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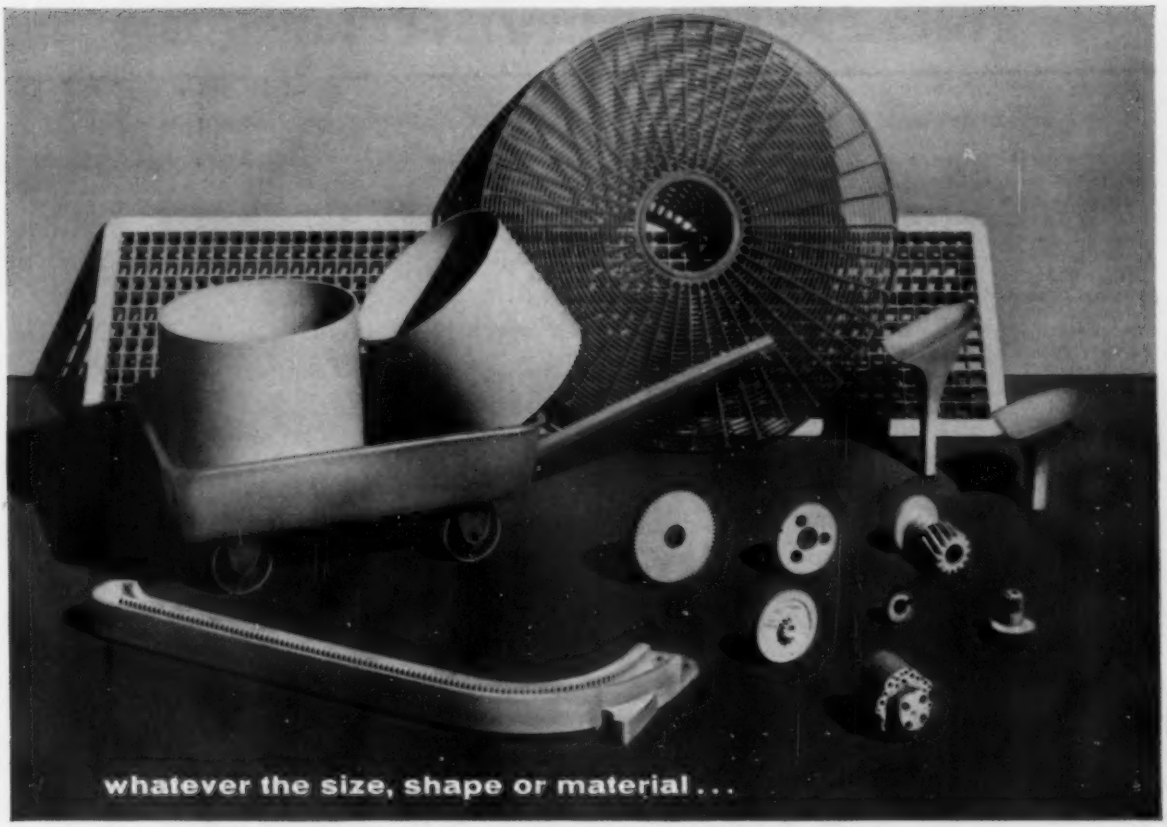

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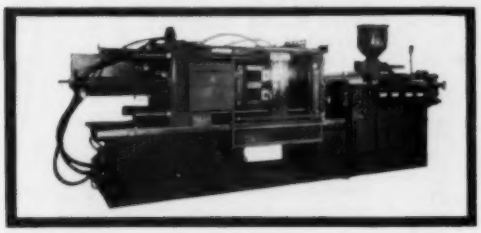

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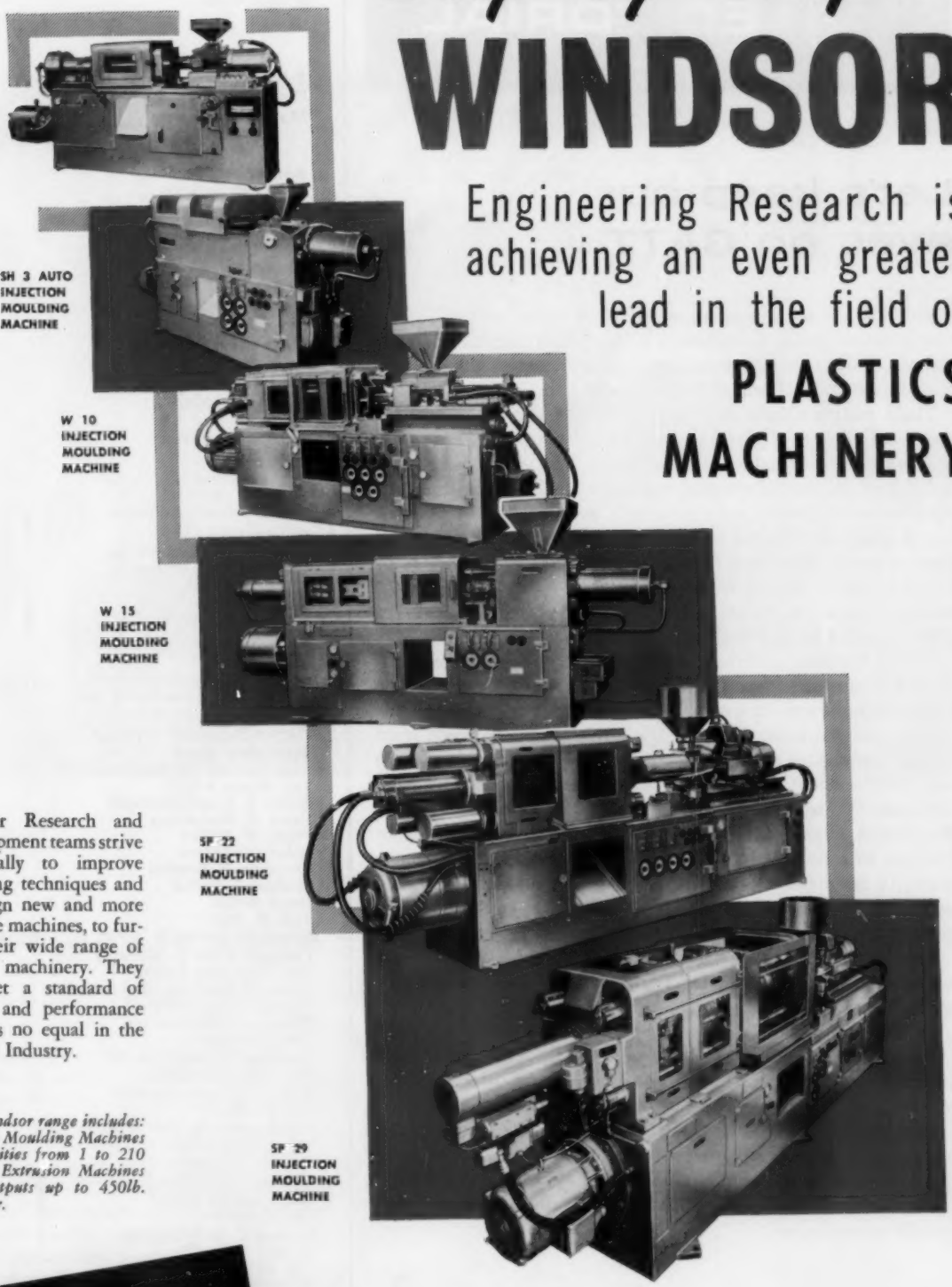

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W 10 INJECTION MOULDING MACHINE

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SP 22 INJECTION MOULDING MACHINE

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EDITORIAL

Let's keep our eyes on GATT

Conversations are now going on in Washington with the Commerce Department, preparatory to tariff and regulatory negotiations with other countries late this year, under the General Agreement on Tariffs and Trade meeting in Geneva.

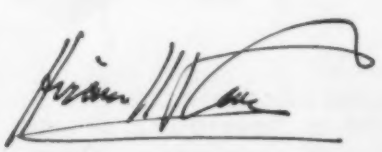
These conversations and the GATT meeting can affect exports and imports of plastics raw materials, semi-finished goods and end-products using plastics. They can affect prices and profits and, on the import end, can affect the health of domestic businesses—in raw materials as well as in processed plastics. Our September editorial showed what can happen in processed plastics items. Raw materials are just as vulnerable. A 4- or 5% volumetric import of a resin at laid-down prices below domestic costs can drive down domestic prices to a danger point in terms of research, development, and marketing.

Unlike finished or semi-finished plastics goods, the problem in raw materials is not one of labor costs. Both domestic and foreign plants are automated. But shipping rates from the U. S. to foreign countries are higher than those between most foreign nations, export licenses are more restrictive, and special "preferences" exist or are being set up in the European Common Market, the European Free Trade Association, and the British Commonwealth Markets. Indeed, our friends in Western Europe can sell where we cannot. Some foreign countries give tax refunds to makers of plastics to encourage export, while others place import duties high, to force quick development of plastics manufacture locally.

Some of these countries, most sophisticated economically and industrially, are being treated by us in trade like underdeveloped nations!

As we said last month, we want to trade materials, goods, know-how. We are willing to invest abroad. We want to help underdeveloped nations improve their standards of living. But we don't want to take a beating for doing these things.

It is all very complicated, but study of the factors involved will be easier if we keep our eyes on GATT. Concerned readers should keep in touch with the S.P.I., and with the Manufacturing Chemists Association. After the election, Congressmen should be contacted.



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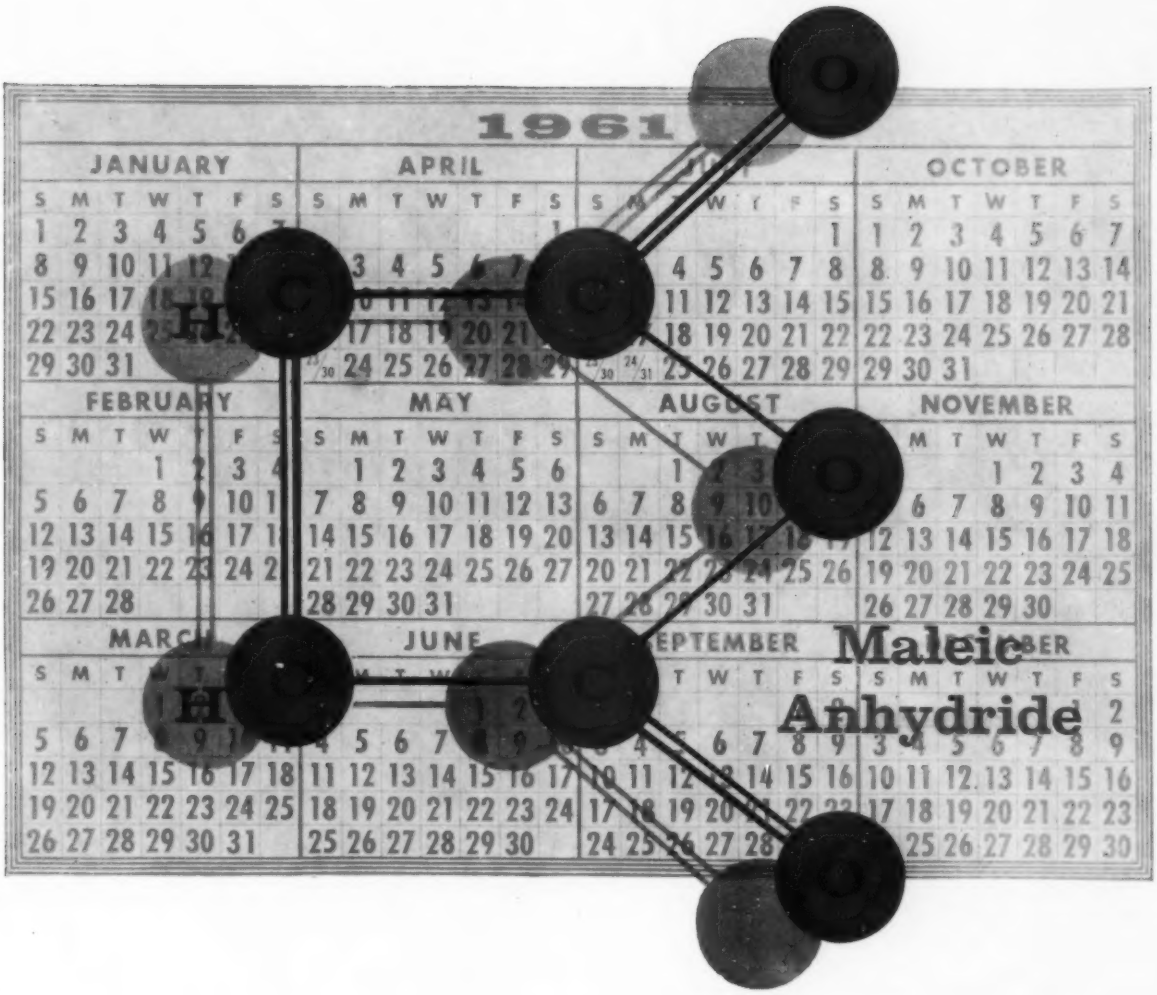

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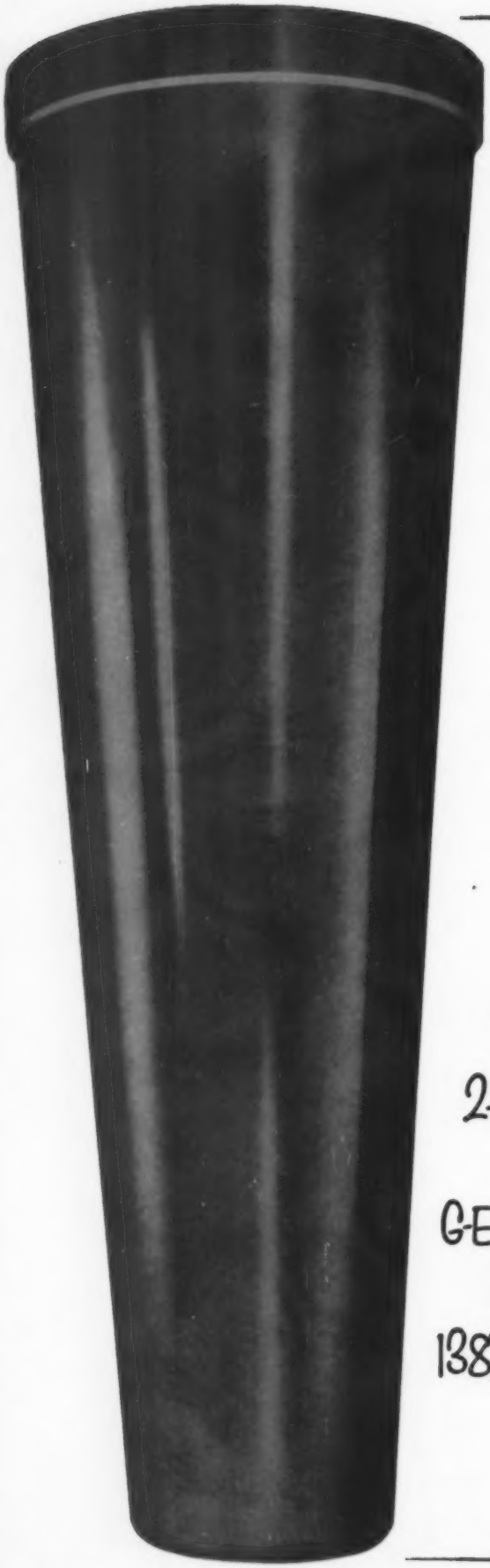

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